

Jan 31, 1957

THE CONDOR

Volume 59

January-February, 1957

Number 1



JOURNAL OF THE COOPER ORNITHOLOGICAL SOCIETY

THE CONDOR

JOURNAL OF THE COOPER ORNITHOLOGICAL SOCIETY

Published bi-monthly at Berkeley, California. Entered as second-class matter at the post office at Berkeley, California, May 15, 1925, under Act of Congress of March 3, 1879. Issued from the office of THE CONDOR, Museum of Vertebrate Zoology, Berkeley 4, California.

MANUSCRIPTS

Send manuscripts for publication to the Editor, ALDEN H. MILLER, Museum of Vertebrate Zoology, Berkeley 4, California, or to the Associate Editor, FRANK A. PITELEA, same address. Refer to suggestions on preparation of manuscripts for THE CONDOR on the back cover of recent issues of the journal.

SUBSCRIPTION RATES

Subscription price to non-members, five dollars per volume, payable in advance. Single copies, one dollar each.

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Issued January 23, 1957

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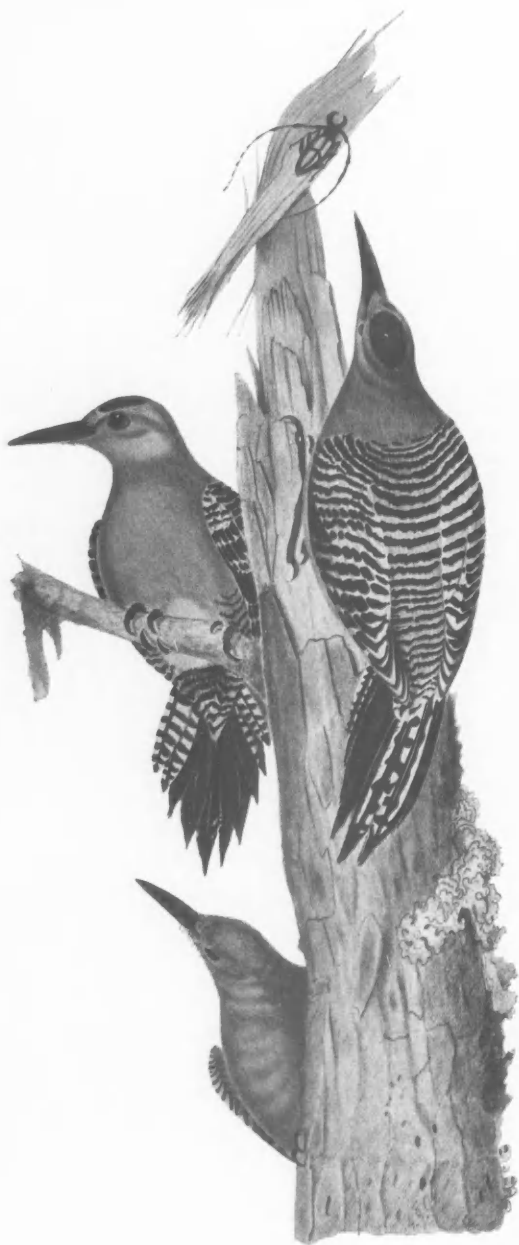
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BERKELEY, CALIFORNIA

1957



GILA WOODPECKER
CENTURUS UROPYGIALIS
One-half natural size

Painting by Andrew Jackson Grayson

THE CONDOR

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NATURAL HISTORY OF THE MONTEZUMA QUAIL IN MEXICO

By A. STARKER LEOPOLD and ROBERT A. McCABE

The Montezuma Quail (*Cyrtonyx montezumae*) is best known in ornithological literature from the extreme northern fringe of its range in southern Arizona, New Mexico, and Texas. There the local race, *C. m. mearnsi*, generally called the Mearns Quail, is extremely rare. Throughout the Mexican highlands, however, the species is widespread and in many localities it is abundant. The natural history and ecological relations of the bird can best be studied in México.

One of us, Leopold, has had the opportunity to observe and collect Montezuma Quail in virtually all parts of the highlands in the course of a survey of Mexican wildlife that has been pursued intermittently since 1944. In the summer of 1948 we both worked rather intensively on the species in northwestern Chihuahua under the auspices of our respective institutions, with some additional support from the Wisconsin Alumni Research Foundation and from the Associates in Tropical Biogeography at the University of California.

Prior to preparing our material for publication, we submitted a questionnaire to most of the museums in the United States soliciting information on existing specimens of *Cyrtonyx*. We are deeply grateful to the many curators who generously responded to our inquiries: R. H. Baker, J. R. Curttenden, W. B. Davis, J. L. Diedrich, W. C. Dilger, W. C. Hanna, T. R. Howell, L. M. Huey, J. B. Hurley, G. H. Lowery, Jr., J. D. Macdonald (British Museum), J. R. Millar, C. E. O'Brien, R. T. Orr, A. R. Phillips, W. L. Schmidt, W. J. Sheffler, K. E. Stager, L. K. SOWLS, R. W. Storer, G. M. Sutton, and Lida Whittier. Records also were sent from the Academy of Natural Sciences in Philadelphia and the Denver Museum of Natural History.

The writers further wish to acknowledge the cooperation and courtesy of Elmer Heft of Green Lake, Wisconsin, who made available quail from his aviary for studies on incubation, growth, and molt.

DISTRIBUTION OF RACES

The species *Cyrtonyx montezumae* is represented by three, well-marked geographic races whose approximate distribution is shown in figure 1. Description of the races may be found in Ridgway and Friedmann (1946). Differentiation is based entirely on plumage characters, not on size. Figure 2 depicts characteristic male specimens of the three races of *montezumae* and the closely allied Ocellated Quail, *C. ocellatus*.

Cyrtonyx montezumae mearnsi occurs in southern Arizona, New Mexico, and Texas as well as in northern México from Sonora and northwestern Coahuila (Sierra del Carmen) south to Durango and probably to central Zacatecas and Aguascalientes. The zone of intergradation with the race *montezumae* to the south seems to occur along the crest of the Sierra Madre Occidental in Durango, Jalisco, and Zacatecas. Five specimens from Las Flores, Durango (7500 ft., 55 km. S Durango City and on the east slope of the Sierra), are clearly *mearnsi*. Presumably this pale race occupies the whole arid interior slope of the Sierra as far south as Aguascalientes. Five additional specimens

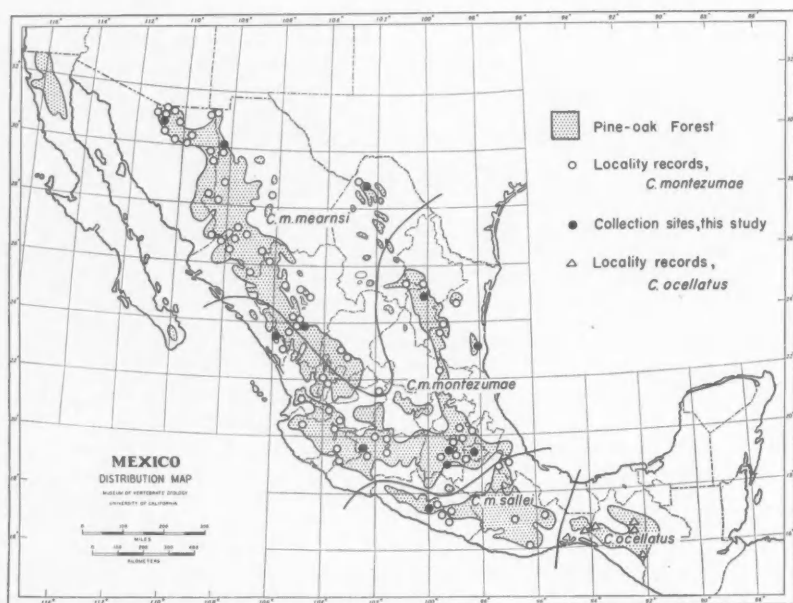


Fig. 1. Mexican distribution of quails of the genus *Crytonyx* in relation to pine-oak forest. Ranges of the three races of *C. montezumae* and of the closely allied *C. ocellatus* are indicated.

taken immediately across the Sierra from Las Flores, on the humid Pacific slope at Batel, Sinaloa (5100 ft., 70 km. NE Mazatlán) are of much darker plumage, being indistinguishable from typical *montezumae* of the southern uplands; comparison was made with specimens from Tequila, Jalisco, Los Reyes, Michoacán, Tres Marias, Morelos, and Río Frío, Estado de México. The zone of intergradation therefore is presumed to follow the Sierran crest as shown on the map.

C. m. montezumae occupies the pine-oak uplands from Sinaloa south to Michoacán, east to Tlaxcala and northern Puebla, and north along the Caribbean escarpment to the Sierra Madre Oriental of Tamaulipas and Nuevo León. To the north and west this eastern segment of *montezumae* is separated from *mearnsi* by deserts. To the south the arid Río Balsas valley intervenes between *montezumae* and the race *sallei* save along the eastern escarpment in Puebla and west-central Veracruz where the two races intergrade. Hellmayr and Conover (1942:285) describe an intergrade from Chalchicomula, Puebla. Even farther east close to the Valley of México some specimens of *montezumae* show a slight tendency toward *sallei* as mentioned by Pitelka (1948).

From Mount Orizaba in the middle of the narrow area of intergradation, Nelson (1897) described a form which has generally been recognized as a fourth race, *C. m. merriami*. The type specimen of *merriami*, a male, and apparently the only one existing, is figured by Nelson (1902) and appears to be an intergrade between *montezumae* and *sallei*. It is peculiar in having the black throat patch directly joined to the chestnut breast, thereby interrupting the normal white collar. However, this character, to which Nelson attaches much importance in differentiating *merriami*, is highly unstable through-

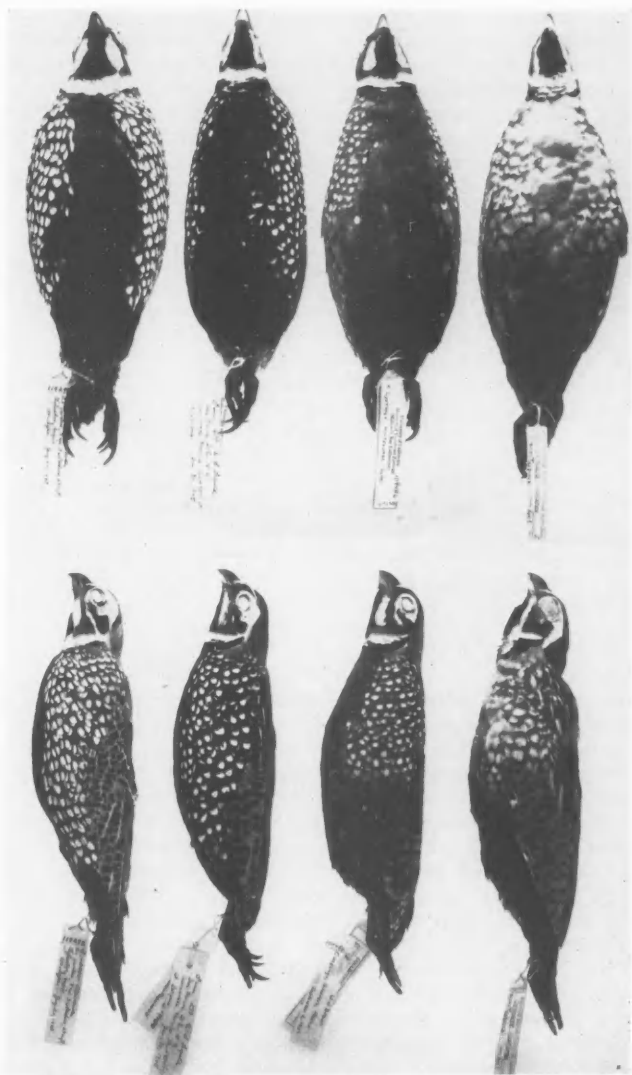


Fig. 2. Left to right, ventral and side views of male specimens of: *Cyrtonyx montezumae mearnsi*, Pacheco, Chihuahua; *C. m. montezumae*, Tres Marias, Morelos; *C. m. sallei*, Cuapongo, Guerrero; and *Cyrtonyx ocellatus*, Teopisca, Chiapas.

out the species and is probably of little taxonomic significance. Among 40 adult male specimens of *Cyrtonyx montezumae* represented in the collections of the Museum of Vertebrate Zoology, white collars vary in width from 4 to 13 mm., some being partly interrupted by scattered black feathers. One specimen of *mearnsi* (no. 98157, Las Flores, Durango) has an interrupted collar precisely as described for *merriami*. Additional specimens from Mount Orizaba would probably have white collars among them as was the case of the specimen already mentioned from Chalchicomula, Puebla, which is only 20 kilometers west of the peak. Hence Nelson's race *merriami* almost certainly represents merely a localized, intergrading population between two well-marked and widely distributed forms, and it is our feeling that the name should become a synonym of *sallei* as suggested earlier by Ogilvie-Grant (1902).

C. m. sallei was long recognized as a distinct species because its markings are so strikingly different from *montezumae*. Ridgway and Friedmann (1946) correctly designated the two forms as races of the same species in view of their intergradation along the eastern escarpment. The richly colored *sallei* occurs in the uplands of Guerrero, Oaxaca, and eastern Puebla as the accompanying map indicates.

To the east *C. m. sallei* is separated from the closely related *C. ocellatus* by a narrow neck of tropical vegetation which crosses the Isthmus of Tehuantepec. These two species occupy precisely the same ecologic niche but are quite distinct in plumage coloration.

RANGE IN MEXICO

Relation to pine-oak zone.—The Montezuma Quail is strictly a bird of the pine-oak vegetation zone. Highest densities are attained in open pine and oak woodland with an understory of low shrubs and tufted perennial grasses. Such conditions occur widely through the Sierra Madre Occidental and locally in the southern uplands both north and south of the Rio Balsas valley. Likewise some good habitat, with accompanying high quail populations, may be found along the eastern escarpment and in the Sierra Madre Oriental. Figure 3 shows typical habitat for *Cyrtonyx* along the Rio Gavilán in northwestern Chihuahua.

Lesser numbers of Montezuma Quail occur in other types of pine-oak associations such as dense pine forest, open pine grassland on the fringes of the boreal zone, and arid oak scrub bordering the desert. We use "pine-oak forest" in a broad sense to include all these types. We have collected Montezuma Quail at timberline on the great volcanoes of central México and at the last outpost of scrubby oaks scattered among the creosote bushes on the edge of the desert. The species shows up on isolated islands of pine-oak far removed from the main upland, as for example in the Sierra de Tamaulipas and the San Carlos Mountains in Tamaulipas, and numerous small mountains in the central desert from Chihuahua and Coahuila south to the border of Guanajuato. But we have not one record of the Montezuma Quail from any other vegetation type.

The pine-oak complex, including all of its varied associations, has been defined and mapped in a previous paper (Leopold, 1950) and is depicted in figure 1. Eighty-seven locality records for Montezuma Quail have been plotted on the map and of these 85 fall within the pine-oak zone as mapped. The apparent exceptions (Cañada, Chihuahua; Cuarenta, Jalisco) are areas that we have visited, and oak scrub occurs in both of them in north-facing canyons. Therefore they are not exceptions but reflect merely inadequacies of our small-scale map. It seems safe to assume, therefore, that the range of *C. montezumae* is fairly well represented by the pine-oak area as shown. Additional isolated colonies of the quail doubtless occupy scattered units of pine-oak not mapped. The quail, in effect, is an indicator species of the vegetation type in all parts of México north of the Isthmus of Tehuantepec except in Baja California where it does not occur.

Likewise the range of the closely related Ocellated Quail in Chiapas and eastern Oaxaca presumably is coincident with the pine-oak highland of the region (fig. 1). Our one contact with *ocellatus* was in typical mixed pine and oak woodland near San Cristóbal, Chiapas.

Habitat requirements.—It is not the pine or the oak trees themselves that make the uplands proper habitat for *Cyrtonyx* but rather the elements of the understory. As will be shown directly, this quail depends for its food and water upon underground bulbs and tubers of the sort that occur specifically in the climatic belt of the pine-oak forest. Removal of the forest by logging does not necessarily spoil the habitat for quail, for we have seen heavy populations in second-growth scrub. Neither does the frequent passage



Fig. 3. Ideal habitat for Montezuma Quail along the Río Gavilán near Pacheco, Chihuahua. The dominant trees are *Pinus montezumae* and various scrubby oaks.



Fig. 4. Former range near Galeana, Nuevo León, in which the birds have been exterminated by overgrazing.

of fire impair the carrying capacity of the range. Much of the pine-oak belt in México is burned annually. Even clearing and cultivating the land will not drive the bird out completely so long as fence rows, gullies, and roadsides remain undisturbed. In parts of Hidalgo, Tlaxcala, and Puebla the Montezuma Quail persists in fair numbers around the edges of fenced corn fields and maguey plantations in former pine-oak country.

Heavy grazing on the other hand will spoil the environment completely by selectively eliminating the bulb-bearing forbs and sedges. These perennials are replaced by annual weeds or by grazing-resistant perennials, such as brush and coarse bunch grasses, that supply adequate cover for the quail but no underground food reserves for the dry season. The quail then disappears.

As any Mexican traveler knows, most of the pine-oak zone in México is grazed, but the intensity of grazing varies greatly. The woods near villages, along watercourses, and on flats or gentle hills are as a rule severely chewed up by livestock. Areas of rough terrain, far from water, or far from population centers are grazed lightly or not at all. It is in these latter situations that the Montezuma Quail is found in good numbers. The condition of the forest canopy does not seem to matter.

Some examples may serve to clarify this situation. In northern Michoacán there are thousands of volcanic cones many of which are steep, rough, and completely dry. These cannot be grazed by livestock because the animals will forage only a mile or so up the

slope from water, which is at the base. The ground flora high on the cones remains rich and varied, and quail are numerous. The lower slopes are grown to poor weeds and there are no quail, although in gross appearance the forest looks the same.

The outskirts of Mexico City are overgrazed and eroded down to the hardpan, but within the suburbs are some ungrazed canyons surrounded by expensive homes. Montezuma Quail occur in the canyons, even though these have gone through a stage of grazing and erosion in the past. Now protected, the ground flora has partly recovered. Often the forest has disappeared or in some places it has been replaced by eucalyptus.

The environmental factor most frequently limiting Montezuma Quail therefore is the lack of underground food reserves which have been destroyed by grazing. If the requisite bulbs are present, the species can tolerate a wide range of cover conditions, from forest to fencerows. Water is no issue, since it is obtained from the bulbs.

We do not claim originality in asserting that grazing is a primary depressant of populations of *Cyrtonyx*. Ligon (1927:140) in New Mexico noted the adverse effects of grazing on various game birds, and of the Montezuma Quail, specifically, he says that "the birds . . . have been . . . reduced in numbers in recent years on account of the destruction of ground cover." In the unpublished field notes of Aldo Leopold appears the entry: "A pair [of Montezuma Quail] was seen in a box canyon above Pueblo Park, New Mexico, July 2, 1933, altitude 6400 feet, ponderosa pine type. This was within a few hundred feet of the only ungrazed spot seen in an eight-mile walk." A. H. Miller in a talk before the Northern Division of the Cooper Ornithological Club (Condor, 1936: 254) discussed the effects of overgrazing on Arizona range of the Montezuma Quail. L. Miller (1943:109) wrote that "overgrazing by domestic animals probably is the greatest danger to the species." In Texas, the Game, Fish, and Oyster Commission (Anon., 1945:67) reports that the range of this quail has shrunk "largely as a result of excessive range use by livestock." A dissenting opinion is expressed by Wallmo (1951: 42-R-2, Job 2, p. 6) who found that "on Fort Huachuca there is better grass cover in the Mearns' [Montezuma] Quail range than elsewhere in the Huachucas but the quail were found in fair abundance throughout the mountains with no apparent relation to range conditions." However, he worked in Arizona in a year of exceptional quail abundance which may have obscured range relationships.

In our experience within the pine-oak zone of México, the abundance of Montezuma Quail is inversely proportional to the local abundance of livestock.

PHYSICAL CHARACTERS AND BEHAVIORISMS

Adult weights.—We have weights of only 67 adult Montezuma Quail, of the 420 adult specimens of which we have record. The average weight of 45 males was 194.9 ± 2.4 grams and of 22 females 175.7 ± 3.4 grams. The heaviest cock and hen weighed 224.5 and 200.0 grams, respectively.

The differential weight of the sexes in this species is unusual for North American quail. In most species males are only slightly heavier than females, or at some seasons (breeding) may even average lighter.

Flight.—The flight of a Montezuma Quail is not unlike that of a Ruffed Grouse (*Bonasa umbellus*); it is usually short in distance but extremely rapid. The breast muscles of both species are light in color, indicating a lack of myoglobin, a muscle hemin-containing protein which combines reversibly with oxygen and is deep red in color. Myoglobin has the ability to hold oxygen in reserve for birds which rely on sustained flight and which characteristically have red muscles, such as ducks and prairie chickens. Miller (1943) discusses the colorless or translucent breast muscles of *Cyrtonyx* and relates this condition to the explosive short flight of the bird. The sustained fliers are

usually slower on the take off than "white-breasted" species. We would be at a loss to say which is faster, the Ruffed Grouse or the Montezuma Quail, but concur with Fowler (1903:68) who thinks that Montezuma Quail "cannot be equalled by any other species of the quail family." They lie very close in coveys and are even less prone to fly when in pairs. The covey separates on the flush like Bobwhites (*Colinus virginianus*). After alighting the birds run a short distance and then hide in the ground cover. Without the aid of a dog they are very difficult to reflush after one flight.

Stevens (1878) states that the female lies closer than the male, but we found no difference in this respect. To indicate the degree to which these quail lie close and restrict their flight, we kept a record of a series of flushes and flight distances (table 1). In four of the five instances when the birds refused to flush, they were with young.

Table 1

Montezuma Quail Flushing Behavior and Flight Distance during the Breeding Season

Jump distances		Flight distances	
Feet	Number	Feet	Number
1-10	7	1-50	0
11-20	4	51-100	2
21-30	2	101-150	10
31-40	0	151-200	3
41-50	0	201-250	3
51-60	5	251-300	0
61-70	0	over 300	1
71-80	2	ran	4
81-90	0		
91-100	1		
over 100	3		

The data substantiate in part what the "white" breast muscles presuppose, namely, that the birds do not fly far. An average flight was scarcely 50 yards. Another peculiarity of flight is the manner in which Montezuma Quail alight after a flight. They seem to tumble to the earth as if shot. Fuertes (1903) aptly describes it as dropping "woodcock-like" into the grass. This awkward landing may be caused by the short, soft tail which is not as efficient a landing mechanism as the tails of other American galliforms.

Voice.—The Montezuma Quail has two principal call notes. The common assembly call used by both sexes and even by chicks is a low quavering whistle in which the notes slowly descend the scale. Fuertes (1903) calls it owl-like. Its ventriloquial character is well known, and trying to locate birds through their vocalization is difficult. On two occasions we confined live juveniles in paper sacks and when all was quiet in camp they would emit the plaintive whistle. Once an adult male responded and came into camp where we collected him. Imitations of the note have been used successfully by us to call both males and females.

An entirely different note is given by males during the breeding season. It is a very high-pitched *buzz* that ascends rapidly to an inaudible level. The call is so high, thin, and reed-like that it sounds more like an insect than a bird. This we presume to be the mating call. It is given largely and perhaps entirely by lone males, who answer and come rapidly to an imitation of the descending tremolo described above, apparently seeking female company. In central Nuevo León in mid-July of 1945, many males were heard giving the *buzz* call and several of them were called up and collected. In Chihuahua in the summer of 1948, on the other hand, we heard very few *buzzing* males.

Jouy (1893:790) tells of a caged bird (probably a male since he calls it a beautiful specimen) in Guadalajara that was "answering its master's call and keeping up a continual piping as long as any attention was paid to it."

On various occasions a squealing call was heard when the birds were flushed. Several writers (O'Connor, 1936; Baird, Brewer, and Ridgway, 1875) speak of a conversational note used by the birds when feeding or in covey. In the Sierra del Carmen, Coahuila, W. C. Russell heard this low chatter among three birds (2 ♂, 1 ♀) observed at 20 feet. He states that the notes were scarcely audible even at that distance.

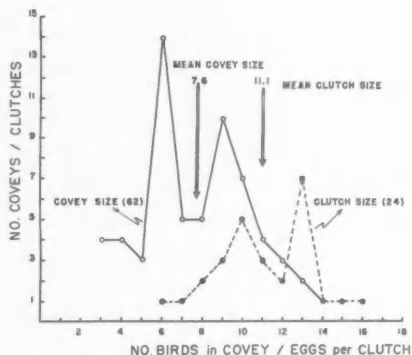


Fig. 5. Data on clutch and covey size, combining our records with those previously published.

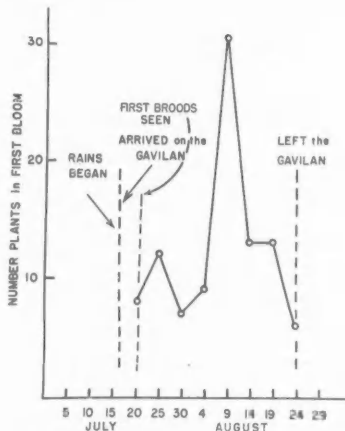


Fig. 6. First broods were observed in the Gavilán area after rains began and flowering plants started to bloom.

Coveys.—Montezuma Quail generally do not form large aggregations. This fact was noted in the earliest reports on the species (Bendire, 1892). Judd (1905) observed that they do not pack, and Bailey (1928) stated of Montezuma Quail in New Mexico that it "does not gather in large flocks." In 1949 Wallmo (1951) observed 15 coveys in the Huachuca Mountains of Arizona that averaged 10 birds and, in 1950, 49 coveys that averaged 8 birds. Henshaw (in Wheeler, 1875) corroborated the tendency toward small coveys when he reported coveys from 4 to 8 birds, seldom exceeding 10. Of our own records of 33 coveys jumped in various places in México in winter (November to March), the average covey was 6.4 and the largest was 10.

The covey is undoubtedly a family unit, but there are sufficient records of large coveys to indicate that some combining occurs: 30 (Brandt, 1951); about 25 (Fowler, 1903); 20 at least (O'Connor, 1936); about 20 (Swarth, 1929). Also Wallmo (1954) observed a group of young birds that included "two age classes."

All covey-size data from published reports were combined with our own, plus information given us by Charles Wallmo of the Arizona Game and Fish Commission. Averages were used when size ranges were given. These data when plotted (fig. 5), show a bimodal curve, with peaks at 6 and 9 per covey. The second peak, at 9 birds per covey, could mean the addition of unmated adults or unsuccessful breeding birds to the covey nucleus. This bimodal curve is strikingly similar to that of the clutch size distribution, to be discussed. When these two curves are compared, the two peaks of each curve are

exactly four units apart. In the case of the clutch-size data, we might regard the peculiar distribution as an artifact resulting from small numbers, but the unique correlation between covey-size and clutch-size is difficult to explain, particularly since the two sets of data are not associated in either time or place. No explanation is obvious to us.

Table 2

Comparison of Covey Sizes in Several Species of North American Quails

Species	Authority	Covey size	Season
Bobwhite	Wilson and Vaughn (1944)	9.11	winter (av. 8 years)
	Jackson (1951)	11.7	fall (av. 3 years)
	Ridley (1952)	11.2	fall and winter
	Rosene (1950)	11-12	fall
	Stoddard (1931)	13.8	winter
California Quail	Sumner (1935)	34.8	winter
Montezuma Quail	This study	7.6	fall and winter

If 7.6 is the average covey size which results from a pair with an average clutch of 11.1 eggs (hatchability unknown), then about a 40 per cent mortality of the eggs, young, and adults takes place between the start of incubation and the time when the group is identified as a covey. The time interval here is about four to six months. Emlen (1940) reports a 91.5 per cent mortality in California Quail (*Lophortyx californica*) from egg to 12 months of age. Unfortunately, we have no hunting-bag data or marked birds in order to compare the Montezuma Quail with other species.

The average covey size is smaller than that of the Bobwhite or the California Quail. The latter two species apparently have a greater tendency toward brood and covey combining. Table 2 presents covey sizes for the three species. In all cases where the observation was labeled a brood, or where the birds were obviously juveniles, the data were not used to determine average covey size.

Movements.—A covey of Montezuma Quail, established on its winter range, is very sedentary. Often we have found fresh scratchings day after day in the same place, indicating that a covey comes there regularly to feed. Miller (1943:106) states that "covies of the birds have repeatedly been located within the same fifteen yards of a canyon's course upon consecutive days or even at longer intervals." On the average we would estimate a covey range to be less than 200 yards in radius.

However, there is a period in the autumn when some coveys seem to move considerable distances before becoming established. Ligon (1946) stated that the bird is "wandering" in habit. Judd (1905) claimed that the Montezuma Quail "is more or less migratory." Several writers (Elliot, 1897; Swinburne in Bendire, 1892; Bailey, 1928) have mentioned an altitudinal movement, which we also have observed on some of the higher mountains of México. But it is our impression that these seasonal shifts, altitudinal or otherwise, are short—never over a few miles. There is nothing comparable to the long semi-annual treks of the Mountain Quail (*Oreortyx picta*), for example.

NESTING

Time of the nesting season.—The Montezuma Quail is a late-nesting bird, although pairs apparently form soon after winter coveys break up. Fowler (1903:68) stated: "I was out in these hills [Carmelita Mountains, Arizona] for a few days in the latter part of March 1892, and found that the Messenas had already paired and were evidently

busy hunting up good nesting places." Wallmo (1954), working on the Fort Huachuca Wildlife Area in southern Arizona, first observed a pair of Montezuma Quail on April 15 in 1949, and on April 11 in 1950. Ligon (in Bailey, 1928) reported them paired by May 15, but he thinks they do not begin to lay until late June. Nest, eggs, and young have been recorded in June, but in northern México we found most of the young appearing about mid-July. Willard (1913) said that they nest "regularly in August." Falvey (1936) stated that they start nesting in late June and that one of his captive pairs began nest building on September 15. Records are common of birds collected in November and December still in partial juvenal plumages.

The lateness of the Montezuma Quail breeding cycle is apparently timed to coincide with the summer rains. In the range of this species the rainy season occurs in July and August, the time we also find eggs hatching and the young in a period of rapid growth.

The chances of survival of young hatched during the pre-rain drought would indeed be slim. We found young quail and adults eating quantities of insects in July and August. Some of these insects, we reason, are made available when rain breaks the dormant period. The sprouting and flowering of plants is for the same reason coincident with the appearance of associated insects. Insects which are both succulent and rich in protein are doubtless the key item in the diet of quail chicks as they are for other gallinaceous birds. Perhaps, also, young Montezuma Quail require water, although adults do not. There is plenty of rainwater for drinking in summer. In any event the correlation between summer rain, plant growth, and nesting of the Montezuma Quail is definite, and this is shown graphically for our study area on the Río Gavilán in figure 6.

One writer (Swarth, 1909:43) speculated that summer rains may be the direct cause for late nesting. He states that "it is possible that the heavy summer rains that occur in the regions inhabited by this species destroy many of the earlier sets of eggs, thus forcing the birds to bring out their young later, but the same reasoning would apply to other species not so conspicuously dilatory."

The fact that there is a lack of cover prior to the greenery fostered by the rainy period was thought by Campbell (1934:202) to be at least one of the reasons why mid-summer nesting is of some survival value. Speaking of an area in southern Santa Cruz County, Arizona, he stated that "the ranchers in the region who are rather sharp observers, maintain that the birds nest in the rainy season, in other words, in July and August. This I was unable to verify, though I believe it to be true. This is the only time they would have adequate cover." We doubt that cover is a critical issue in the timing of breeding.

Aviary-bred quail at Green Lake, Wisconsin (about 44° N) gave us a chance to make comparisons with conditions in the southwest at Tucson, Arizona (about 32° N). The north-south distance between these two points is roughly 650 miles. Kirkpatrick and Leopold (1952) and Glass and Potter (1944) call attention to the effect of photoperiodism on the sexual physiology of the Bobwhite Quail. From these works it seemed logical to assume that captive Montezuma Quail breeding in Wisconsin would respond to light intensities comparable to those occurring during the breeding season in their native range (Tucson, Arizona).

In terms of day length, both places have about the same number of hours of light on March 21 (and again on September 21), but Green Lake builds up more rapidly so that at the peak of day length on June 21, there is about 70 minutes difference between Green Lake and Tucson. The longest day at Tucson is 14 hours and 10 minutes. This day length occurs at Green Lake on May 1.

In the wild, Montezuma Quail begin to lay at the earliest about June 1, or 20 days before the peak period of day length. At Green Lake, Wisconsin, the same period of day

length would come about April 10. The onset of laying in the Heft aviary at Green Lake, for at least three years, has been in mid-June (June 10, 1952; June 11, 1953; and June 19, 1954), the same time as for the Montezuma Quail in Arizona. What this means is not clear. It appears, however, that the breeding cycle of pen-reared birds in Wisconsin does not respond to the same photoperiod as wild raised birds in the Southwest.

In summary, the timing of the nesting season is such that broods appear shortly after rains have made dormant plants sprout green leaves and flowers. At this time, also, there appear to be plenty of free water, succulent plant parts above the ground, and an abundance of succulent insects. This period in the range of the Montezuma Quail occurs in July and August.

Nest, eggs, and incubation.—The Montezuma Quail, like all New World quails (Odontophorinae) builds its nest on the ground. Unlike the nests of other members of this group, those of the Montezuma Quail are domed or roofed over. Some writers (Bailey, 1902; Headstrom, 1951) have indicated that the cavity is partly arched over, while Poling (in Bendire, 1892) claimed that it is so completely roofed as to require a tunnel entrance. Falvey (1936) adds that the nest is so thoroughly roofed over as to be "practically waterproof." The best nest description is given by Wallmo (1954:126) who noted that "the nest [no. 1] was placed against the base of a small Arizona oak and consisted of a chamber sparsely roofed with bedstraw (*Galium* sp.) and bullgrass (*Muhlenbergia emersleyi*). The floor was lined with dry leaves of Arizona oak. Interiory it was about 5 inches wide and 4 inches high."

A scrape is made prior to nest construction, and according to numerous authors varies considerably in depth. G. W. Todd (in Bent, 1932) recorded one so deep as to make the top of the nest level with the surrounding ground.

No one has recorded observing the Montezuma Quail building a nest in the wild. Falvey (1936), however, claimed that a captive male and female jointly constructed a nest. This cooperative effort seems to be in keeping with the general attentiveness shown by the male during the breeding season. Falvey also stated that the hen covers the nest entrance after laying. We assume this refers to the period when the eggs are being deposited in the nest. Once laying is completed and incubation is underway, it seems unlikely that the entrance would be closed. Pearson (1917) and St. John (in Wallmo, *loc. cit.*) also pointed out that the nest entrance is sometimes sealed. This act appears comparable to egg covering during the laying period by other ground-nesting galliforms. It is little wonder that nests are difficult to find if they are roofed over and sealed.

The eggs of a Montezuma Quail are chalky white. They are similar in appearance to those of the Bobwhite, except that the apex is noticeably less pointed. Twenty eggs measured by us averaged 32.2 mm. (31–34) by 24.9 mm. (24–25.5), which dimensions do not differ significantly from measurements given by Bent (1932) and others.

We found no information on egg weights in the literature. However, we were able to obtain the weights of 15 fresh eggs from two females kept at the Elmer Heft Aviary, Green Lake, Wisconsin. The mean weight was $10.59 \pm .25$ grams and the heaviest and lightest eggs weighed 11.2 and 10.2 grams, respectively.

Clutch size varied from 6 to 16 eggs. All available records of clutch size were taken from the literature and to these data were added records of egg collections from a number of museums and private egg collections. When the data were plotted, a peculiar curve resulted (fig. 5), with peaks at 10 and 13 eggs. This variation was very likely the result of our small sample. Numerous accounts list the clutch size as an indefinite number, "about 10" or "8–12." It was difficult to tell when one author was quoting another; in no case were such data used in the graph. No generalized clutch size ranged over 12. The average for the exact records was 11.1 eggs per clutch.

The seasonally late start in nesting virtually precludes the possibility of a second nesting. Only Falvey (1936:241) claimed that a second clutch is laid. We collected a female on August 20 with a completely formed egg low in the oviduct. It might be assumed that this bird was attempting a second nest, but on examination we found only nine ruptured follicles in the ovary. This case indicates instead that a first nesting can occur as late as August 20. Four other ovaries were examined for ruptured follicles, and the counts were 12, 13, 13, and 16, respectively. Some of the enlarged follicles remaining after the last egg was laid could have become atretic and appeared as ruptured follicles. Under penned conditions where eggs are removed to perpetuate laying and discourage broodiness, a female may lay as many as 35 to 40 eggs. Two birds laid 62 eggs in the Heft aviary in 1953, one contributing about 40 eggs.

The incubation period previously has been unknown. Falvey (1936:227) had a reasonably good record of a clutch gathered in the wild and set under a bantam. He states of this clutch that "on the twenty-first day they started to pip their eggs, and all were out by the twenty-fourth day." The circumstances, too long to discuss here, were such that the assumed incubation period could have been in error by 24 to 28 hours.

At the Elmer Heft aviary in 1953 two clutches of fresh eggs that had been gathered daily from two laying hens were incubated. One clutch was placed in a standard electrically controlled incubator and the other set placed under a bantam. The eggs placed in the electric incubator hatched in 25 days and those under the bantam in 26 days. Another incubator setting in 1954 came off in 26 days. The incubation period as we have used it is the interval from the onset of incubation to the emergence from the egg of the last chick in a given clutch.

The speed of emergence may vary according to attentiveness of the hen, climatic conditions, and clutch size, but in any event it should have no appreciable effect on the incubation period. The following is an excerpt from McCabe's field notebook, concerning the 15-egg clutch hatched in the electric incubator: "These eggs began pipping Thursday, August 6, 1953, some time during the morning. The first bird was out of its shell and partly dry between 11:00 a.m. and 12:00 noon on Friday. All were hatched by 5:00 p.m. except three that were infertile." It appears that it takes between 24 and 36 hours from the onset of pipping to the hatching of the last egg. This interval is shorter than observed by Falvey (*loc. cit.*) for a clutch hatched by a bantam.

The incubation period according to our findings is therefore 25 to 26 days, which is a day or two longer than that in other North American quails.

Care of young.—Montezuma Quail broods are reared by both parents. The male is attentive and assumes an equal share in bringing up the brood. Bent (1932:86) quotes Frank C. Willard to the effect that both sexes incubate and that "in about half of the nests examined the male was on the eggs." How common this is has not been verified, since there were no other records of follow-up examination once a nest was found. Floyd Johnson of Colonia Pacheco, Chihuahua, told us that he once flushed a female from her nest and a male apparently sitting beside the hen also flushed. He has seen a number of nests but has never observed the male incubating. It is likely, however, that the male shares in incubation in the light of his ardent attentiveness toward the brood.

In our experience, the male never deserted the young when the brood was discovered. The female is no less active in protecting and caring for the brood. On one occasion in the Gavilán River area of northwestern Chihuahua, a pair and brood were encountered. The male immediately feigned injury and floundered about in the grass. The female concentrated her efforts on one of our horses. Twice in rapid succession she hovered in the horse's face, weaving back and forth in the air like a hummingbird. In the confusion that ensued, the young made good their escape into the tall grass.

In the same area one evening we came upon a family that had gone to roost on the side of a mesa in the shelter of zacate (*Muhlenbergia* sp.) and a prickly ceanothus patch (*Ceanothus huichagorare*). The male, with crest spread, looked twice normal size. Protruding from under the extended breast feathers was the entire brood of about eight chicks which were two to three days old. The female was only a few feet away. Both birds remained motionless for a moment and then began to vocalize with a husky churring sound and dashed madly about. We caught several of the chicks whose frantic peeping called the adults into view several times. In this encounter also, a good view was had of the lateral spreading of the crest on the male. The young were released and the brood re-assembled higher up the slope. This brood was never again seen in the same area, although several attempts were made to relocate it at roosting time.

On another occasion, the male was much more tenacious in staying with a brood after it was discovered than was the female who retreated to safe distance. The male fluttered very close to the intruder and only after the brood was well hidden did he attempt to escape.

Broods.—The degree of mixing of broods is undoubtedly a function of population density. The brood with two age classes observed by Wallmo (1954) occurred when the birds were more numerous than they had been for many years. Since the Montezuma Quail rarely attains the high densities reached by most other quails, there is little likelihood of numerous broods of mixed age groups. That such broods exist, however, is attested by Kennerly (in Baird, Brewer, and Ridgway, 1875), who claimed that October and November coveys contained birds of various ages from the "very small and partly fledged to the full grown bird."

The amazing speed with which the chicks can scatter and hide is common knowledge to those who have observed a brood in peril. It is often impossible to get even an approximation of the brood size, so that exact brood counts are rare. Brood data recorded in the literature that were reasonably precise, plus our own of like quality, are shown in table 3. Only those records in which the group was obviously a brood and not a covey were used. The average size of ten broods was 8.4—about three birds less than the average clutch size of 11.1. Wallmo's data, which include only those groups in which the young could be distinguished from the adults, show an average of 6.6 birds per brood. The calculated hatching dates range from July 1 to August 28.

Growth of young.—The newly hatched Montezuma Quail weighs about 7.7 grams (14 specimens). On an average, the shell, egg membrane, allantois, and extra body fluids weigh only 2.9 grams. An egg and day-old chick are shown in figure 7.

The young from two sets of eggs hatched in captivity 11 days apart were weighed at 6 to 10-day intervals for 12 weeks after which several additional weighings were made in order to ascertain the adult weights. Adult weight, as we use it here, is that attained at the time when the bird is full-winged and in complete first winter plumage. The growth data are shown in figure 8. The growth rate follows the typical sigmoid curve, reaching an asymptotic level at about 190 grams. The average weight of wild adults (both sexes together) was 188.6 grams, indicating a very close correlation with the weights attained by the hand-reared birds. A cock and a hen, weighed only once at 25 weeks, weighed 202.7 and 174.1 grams, respectively, indicating that handling birds weekly had no effect on their adult weights. The adult weight was reached in 10 to 11 weeks by the aviary birds. How long it would take in the wild is a matter of conjecture, but in general the growth curve in figure 8 appears to be normal for what we know of wild gallinaceous birds.

The contour feathers of the first winter plumage are complete by 15 weeks, but the eighth primary (nos. 9 and 10 are not shed in the postjuvinal molt) which sheds in the

Table 3
Montezuma Quail Broods

Date observed	Size	Approximate age	Calculated hatching date	Authority
July 11	? (1)	10 days	July 1	This study
July 12	? (1)	1 day	July 11	This study
July 16	2	.....	.....	Wallmo (1954) *
July 20	? (3)	2-3 days	July 17	This study
July 25	7-8	3 days	July 22	This study
July 27	12	1 week	July 20	Bendire (1892)
July 29	9-10	3 days	July 26	This study
Aug. 3	10	.....	.....	Wallmo (1954)
Aug. 4	5	.....	.....	Wallmo (1954)
Aug. 5	5	.....	.....	Wallmo (1954)
Aug. 9	8	5 days	Aug. 4	This study
Aug. 9	8	2 days	Aug. 7	This study
Aug. 9	6	% grown	.....	This study
Aug. 10	8-10	1 week	Aug. 3	Wheeler (1875)
Aug. 12	9	.....	.....	Wallmo (1954)
Aug. 12	6	½ grown	.....	This study
Aug. 15	6-8	5 days	Aug. 10	This study
Aug. 31	12	3 days	Aug. 28	Bendire (1892)
Sept. 7	7	.....	.....	Wallmo (1954)
Sept. 28	11	.....	.....	Wallmo (1954) 2 age classes in this brood
Oct. 6	7	.....	.....	Wallmo (1954)
Oct. 6	7	.....	.....	Wallmo (1954)
Oct. 9	4	.....	.....	Wallmo (1954)
Oct. 30	11	.....	.....	Wallmo (1954)
Oct. 31	1	.....	.....	Wallmo (1954)

*Wallmo states (p. 125), "These brood counts may not in all instances represent the entire brood."

Table 4
Age in Days at which the Primary Feathers are Drooped in the Postjuvenile Molt of Various Gallinaceous Birds

Primary	Ring-necked Pheasant	Hungarian Partridge	Bobwhite Quail	Montezuma Quail	Wild Turkey
1	28	28	28	?	39
2	35	35	35	?	46
3	40	42	42	42	53
4	46	49	49	49	60
5	56	56	56	56	67
6	63	63	63	77	81
7	70	77	74	98	98
8	77	91	102	119	133
9	84	....	....	....	....
10	91	....	....	....	....

Bobwhite: Petrides and Nestler (1943).
Hungarian Partridge: McCabe and Hawkins (1946).

Pheasant: Buss (1946).
Wild Turkey: Leopold (1943).

17th week, is not replaced and fully grown until the 19th week (133 to 135 days). Feather replacement and growth may be accelerated in the wild. The rate of primary replacement compared with several other upland game birds is shown in table 4. Unfortunately we did not determine at what age primaries one and two were shed by Montezuma Quail, but from the close correlation with the molt pattern in the Bobwhite and Hungarian Partridge (*Perdix perdix*), the beginning of the sequence in Montezuma Quail should be about the same. The lag in shedding of primaries 6, 7, and 8 is more like that found in the Wild Turkey (*Meleagris gallopavo*). The Ring-necked Pheasant (*Phasianus torquatus*) as shown does not hold juvenal primaries 9 and 10 into the first winter.

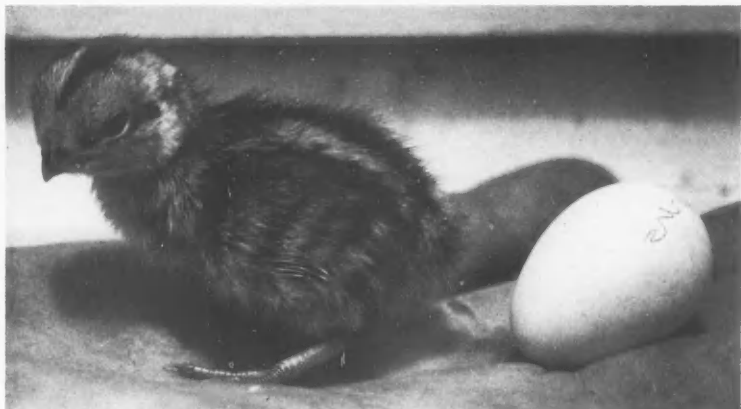


Fig. 7. Egg and day-old chick of Montezuma Quail (Heft aviary).

The data in table 4 may have suffered slightly in reducing fractions of weeks, given in the original sources, into days used in the tabulation. The variation within each species is doubtless greater than the error in reducing all time data to days. The molt sequence could be used as a crude indicator of age.

FOOD HABITS

To our knowledge there is no single paper in the ornithological literature dealing at any length with the food habits of *Cyrtonyx*. Martin, Zim, and Nelson (1951), in their valuable summary of plant foods of American wildlife, list a total of only 39 specimens of Montezuma Quail available to them for study, none of which came from the spring or fall season.

The Montezuma Quail is a bird of México and the arid southwest and must therefore adapt itself to long rainless periods. Plants of such a region must likewise adjust to prolonged drought. One of the ways this is done, particularly by perennial herbaceous plants, is to form bulbs or tubers which can survive seasonal droughts. These dormant plants, high in stored nutrients, are dug up and eaten by the quail. Morphologically *Cyrtonyx* is well equipped for digging with its stout legs and long toes and claws, as has been shown by Miller (1943).

With the coming of the summer rains and lush vegetation the annual crop of insects

becomes available and the quail shift their diet from plant to animal foods. Unfortunately the seasonal picture of the ratio of animal to vegetable food is incomplete. Martin, Zim, and Nelson (*loc. cit.*) show that 71 per cent of the winter diet is made up of vegetable matter, while in the summer only 3 per cent is vegetable. Our quantitative data were gathered in summer but at a time when the rains were just beginning. In all, we collected and analyzed the crops of only 15 Montezuma Quail, although many more were examined in the field at other seasons and in other places. If 0.05 cc. is arbitrarily

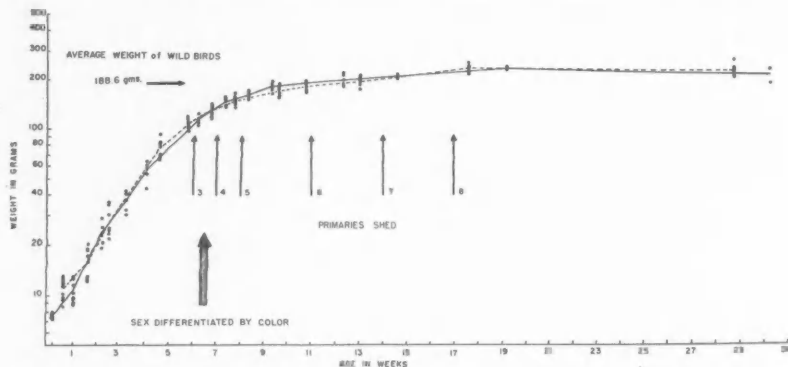


Fig. 8. Weight curve and records of primary feather replacement obtained from two broods of pen-reared Montezuma Quail (Heft aviary).

allowed for each item listed as a *trace*, on a volumetric basis we found that 38 per cent of the food eaten in summer was vegetable. Neither the data presented here nor those of Martin, Zim, and Nelson are sufficient to be more than suggestive on a seasonal basis.

Plant food.—No single investigation lists many different food items but when a number of such investigations are taken in aggregate the list becomes rather long. Thus in grouping ten earlier studies with our own, 24 plants from 18 different families are known to be eaten by Montezuma Quail (table 5).

The most frequently recorded item in the diet of this quail is the general category "bulbs." Identification of plant bulbs is difficult and frequently no specific plant names accompany field records. For this reason complete scientific names for bulbs are not used in the table. Our experience in identifying bulbs and tubers was disappointing. Only after much trial-and-error digging at likely feeding sites were we able to locate bulbs similar to those we had found in quail crops. In many instances it was impossible to find bulbs even by digging in areas where quail had fed. A number of bulbs taken from quail crops and planted in a greenhouse failed to grow. It was only when a recognizable portion of a bulb adhered to the roots of a sprouted plant that the kind of plant could be determined. A few species were identified in this way. Throughout the Mexican range of *Cyrtonyx* these bulbs are paramount in the winter diet. The bulb of nut grass, *Cyperus esculentus*, we feel is most common although positive identification is difficult. Some bulbs tasted nutty, others were onion-like, some tasted starchy like a potato, and others were tasteless.

Montezuma Quail diggings are very typical (fig. 9). The bird digs a hole about two inches long, one inch across, and from two to three inches deep. Soil is usually pulled to one side of the cone-shaped excavation, the open end of which is oval. The apex is pre-

Table 5
Food Items Eaten by Montezuma Quail

Family	Genus-species	Plant		Reference
		Common name	Part eaten	
Fagaceae	<i>Quercus virginiana</i>	live oak	acorns	x, 2, 4, 5, 8, 9, 10
Liliaceae	Sp.	lily	bulbs	x, 2, 6
	<i>Echeandia terniflora</i>	lily	tubers	x
	<i>Brodiaea</i> sp.		bulbs	10
Cyperaceae	<i>Cyperus esculentus</i>	sedge	bulb	x, 5, 7, 10
Leguminosae	Sp.	legume	seed	x, 2
	<i>Acacia</i>	acacia	seeds	2
Gramineae	<i>Triticum aestivum</i>	wheat	seeds	x
	<i>Zea mays</i>	corn	seeds	10
Solanaceae	<i>Physalis</i> sp.	ground cherry	fruit	x
Ranunculaceae	<i>Ranunculus geoides</i>	buttercup	tubers	x
Cactaceae	<i>Opuntia</i> sp.	prickly pear	fruits, seeds	1, 6, 10
Euphorbiaceae	?	spurge	seeds	2, 10
Ericaceae	<i>Kalmia latifolia</i>	mountain laurel	fruits	2, 4, 5
	<i>Arbutus</i> sp.	madrone	fruits	2, 4
Pinaceae	<i>Juniperus</i> sp.	juniper	fruits	2, 4, 5
	<i>Pinus cembroides</i>	piñon pine	seeds	2, 7
Zygophyllaceae	<i>Kallstroemia maxima</i>	caltrop	fruit	10
Oxalidaceae	<i>Oxalis</i> sp.	wood sorrel	bulbs	10
Anacardiaceae	<i>Rhus</i> sp.	sumac	fruits	7
Polygonaceae	<i>Eriogonum</i> sp.	eriogonum	foliage (seeds?)	10
Convolvulaceae	<i>Ipomea</i> sp.	morning glory	seeds	10
Compositae	<i>Helianthus</i> sp.	sunflower	seeds	10
Linaceae	<i>Linum</i> sp.	flax	green fruits	x

Animal		Reference
Scientific name	Common name	
Hymenoptera	unidentified 4-winged insects	x
Formicidae	ants	x
Diptera	flies and maggots	x, 10
Lepidoptera	larva or caterpillars	x, 1, 2, 10
Coleoptera	beetles	x, 10
	weevils	x, 1, 2, 10
	lady beetles	x
	darkling beetles	10
	ground beetles	10
Homoptera		
Cicadellidae		
<i>Manzutus multilineata</i>	leaf hoppers	x
Orthoptera		
Locustidae	grasshoppers	x, 1, 2, 3
Gryllidae	crickets	3
Isoptera	termites	x
[larva unidentified]		1, 2
Araneida	spiders	1, 10
Chilopoda (class)	centipedes	10

References: 1, Bailey (1902); 2, Bailey (1928); 3, Cassin (1862); 4, Bendire (1892); 5, Grinnell (1910); 6, Judd (1905); 7, Ligon (1927); 8, Miller (1943); 9, Van Tyne and Sutton (1937); 10, Martin, Zim, and Nelson (1951); x, this study.

sumably the site of the bulb. Dried hulls which encased them could usually be found in or near the holes from which the bulbs were dug. Diggings occurred in many places within the quail habitat, but were most frequent along dry mesa slopes. Quail commonly scratched and dug around the edges of large buried stones or boulders and at the base of grass clumps.

Acorns are probably the most abundant, available, and nutritious of the foods to be found in the pine-oak forest biome. Miller (1943) comments on the importance of acorns



Fig. 9. Typical digging of Montezuma Quail. The hole is about two inches deep, and on the mound of dirt are hulls (arrow) of the bulbs that were dug up and eaten.



Fig. 10. Leafhoppers, grasshoppers, and miscellaneous seeds found in crop of a Montezuma Quail (Río Gavilán, Chihuahua, August 12, 1948).

as food for Montezuma Quail, and we likewise have noted them in many crops. The bird seems to be able to remove the hull and eat only the meat. The occurrence of domestic grains in some quail crops indicates that the birds occasionally use cultivated fields as a source of food, but this is not customary.

Animal food.—Insects in general are dependent on green plants. With the coming of the rains, dormancy is broken in bulbs and tubers, and green foliage appears. Moisture also promotes the maturation and breeding of many insect forms. Relative abundance of insects may be indicated by the amount of green vegetation and this in turn by the number of plants in first bloom following the onset of the rainy season. These data for northern Chihuahua have already been presented in figure 6. Quail diet shifts from vegetable to animal food in this period of lessened availability of bulbs (which have sprouted) and the greater availability of insects living on the growing plants.

Insect food appears to be a matter of feast and famine. Only the records from June, July, and August show an appreciable amount of animal food (68 per cent of the over-all diet). Birds collected in January, April, October, and November had eaten predomi-

nantly vegetable matter. When insect food was available it was eaten avidly. For example, the crop of one adult male which we collected contained 115 lepidopterous larvae, a grasshopper and a small amount of vegetable matter. Another had in its crop 111 leaf hoppers (*Manzutus multilineata*), 5 grasshoppers, and 14 small seeds (fig. 10).

We found no evidence that these quail feed anywhere except on the ground.

Water needs.—Vorhies (1928) kept two immature *Cyrtonyx* in an enclosure for two and one-half months without water with no apparent ill effects. Seeds, an occasional boiled egg, and bits of apple were the only food given these birds. They foraged for grasshoppers in the early part of their confinement. One bird died from unknown causes and the other lived an additional month and a half before it was turned over to an aviary.

We found Montezuma Quail in abundance in the absolutely waterless Cerro Hueco in the state of Michoacán. There is no livestock in this area because of the water shortage. In several other instances Montezuma Quail were found in areas far removed from a water source. McCall (1852) remarks on their occurrence in areas of west Texas where water was scarce.

The only report of drinking we were able to find is one record by Smith (1917:162) who stated, "I flushed a single bird September 26 while it was drinking at a tiny stream flowing in a deep canyon, at an altitude of 6500 feet." However, Montezuma Quail frequently forage along stream banks, so that merely flushing a bird would not constitute proof that it was drinking. We have never opened a crop that contained water.

Montezuma Quail very likely drink dew when it is available, but we believe their ability to withstand arid conditions is primarily a matter of obtaining water from their food.

POPULATIONS

Sex and age ratios.—Our only sources of sex and age data in populations of Montezuma Quail are the specimens that we ourselves collected plus additional museum specimens on which we have records. In the case of other quails, museum specimens have been found to give a fair cross section of normal sex and age distribution, "normal" being determined by such other sampling methods as hunting-bag checks and trapping records. Admittedly there may be some selective shooting of adult male Montezuma Quail, in fact we ourselves have on occasion chosen males when there was time and opportunity to be selective. So we cannot say that our sample accurately represents the normal distribution of sex and age groups in the wild. However, it is the best we have.

Of 57 Montezuma Quail in the collections of the Museum of Vertebrate Zoology at the University of California, the categories are represented as follows:

	Adults		Immature		Total
	Male	Female	Male	Female	
Number	13	9	20	15	57
Percentage	23	16	35	26	100

Sex was recorded from the labels. Age was determined from the appearance of the greater upper primary coverts as described by Leopold (1939). The differences between adult and juvenal coverts are subtle, but they can be recognized. Adult coverts are clearly barred or spotted with whitish buff; juvenal coverts are mottled with ochraceous buff.

From the preceding sample, therefore, the age ratio is 39 per cent adults and 61 per cent juveniles, or 156 young:100 adults. This is average for arid-land quails which generally run between 50 and 70 per cent young.

The sex ratio in this sample is 58 per cent males, 42 per cent females, or 138 ♂♂:

100 ♀. We have a much larger sample by including other museum specimens on which we have sex but not age data. In 502 such specimens we find a sex ratio of 63 per cent males and 37 per cent females, or 170 ♂ : 100 ♀. The weighting of males might be real or might be an artifact of selective collecting.

This can be checked by segregating sex data on juveniles, which presumably would not be selectively taken. There were 98 specimens designated as juveniles in the museum records sent to us (for example, "partly downy young," "bird one-third grown," or "bird in juvenal plumage"), of which 63 per cent were also male. The collecting bias, if it exists, would likely not hold for these comparatively drab young, yet the percentage of males is identical with the adult sample. Another sample of 84, including downy young less than three days old, 22 of which were collected in the wild but most of which were hatched in the Heft aviary, showed 50 males to 34 females, or 59 per cent males. Although the sample is not statistically significant, there is a strong suggestion that the discrepancy begins at hatching, which is contrary to the conclusion reached by Leopold (1945) regarding the excess of males in Bobwhite populations.

Fluctuations in population density.—We have only two estimates of actual populations of Montezuma Quail. Wallmo (1951) records the presence of at least 45 birds on about 1120 acres in the Huachuca Mountains of Arizona, or 26 birds per section. In the summer of 1948 we attempted a rough census of quail in the Gavilán basin of northern Chihuahua. All encounters with Montezuma Quail, as well as signs of fresh scratching, were recorded and mapped, from which data we estimated a minimum population of 28 to 30 adult quail per section. These may be considered conservative counts in fairly well populated range. In other parts of México, and in the Gavilán area itself ten years earlier (winter 1937–38), there existed much higher numbers of Montezuma Quail, but we failed to record estimated densities.

In any given area, the population of these quail may go up and down violently. Swarth (1904:4) illustrates the ephemeral nature of Montezuma Quail populations when he stated that "in the summer of 1896, with four of us scouring the mountains [Huachucas] daily, but two pairs of birds were seen, though two years later in 1898, Mr. O. W. Howard found them to be most abundant in the same region. In 1902, in spite of all our efforts, Mr. Howard and I were unable to find a single bird, and in the following year, 1903, though informed of their occurrence in various places by inhabitants of the mountains, I saw just three myself." Wallmo (1951) working in this same region of Arizona 50 years later found this quail to be relatively abundant.

One cause of sudden decline in Montezuma Quail is periodic winter mortality resulting from abnormally deep snow. Such a case was reported to us by Floyd Johnson of Colonia Pacheco, Chihuahua, where between January 6 and 22, 1946, a heavy snow fell in the table lands covering the ground up to 16 inches on the level. The temperature dropped to -20°F . This period of severe weather killed off nearly all the quail in that region. Ligon (1927) and O'Connor (1936) also called attention to the lethal effects of a deep blanket of snow that prevented the quail from digging in the ground for food. Severe weather very probably limits the range of the species to the north and on high peaks.

Another adverse weather factor is drought, which might well preclude successful nesting. Smith (1917) recorded a drop in population following several successive dry years, and in various parts of México we were told by native people that lack of rain was a cause of quail shortage. Certainly this is true of other arid-land quails. The effect of drought upon the quail is complex and may involve inadequate nutrition of the adults, lack of moisture to hatch the eggs, or lack of insects to rear the young.

Long-term downward trends in local populations of this quail are usually a result of

increased grazing, a factor already discussed. As land-use pressure increases in México there is a tendency to spread domestic livestock into all parts of the mountains where water exists or where it can be impounded or otherwise provided. This is by far the most critical factor in regulating quail numbers.

Mortality.—We have virtually no direct evidence of predation on the Montezuma Quail, although this bird is probably as vulnerable as any other quail. Ligon (1927) considered the Cooper Hawk (*Accipiter cooperii*) one of the main predators. This statement, which is doubtless correct, has been parroted by other writers, but we find no published records of Cooper Hawks killing Montezuma Quail. Miller (1943) described the attack of a Loggerhead Shrike (*Lanius ludovicianus*) on an adult quail, but no damage was done. It is also his opinion that the coati-mundi (*Nasua narica*) and peccary (*Pecari tajacu*) cause nest destruction. We, too, feel that these mammals are the most likely nest predators, along with the raccoon (*Procyon lotor*) and the several species of skunks (*Mephitis*, *Spilogale*, *Conepatus*).

We came upon the scattered remains of an adult male Montezuma Quail at Casita, Sonora, and from the sign attributed the kill to an owl (probably the Horned Owl, *Bubo virginianus*).

O'Connor (1936) presented to the sportsmen a long list of "suspected" predators of Montezuma Quail. Prominent in the list is the coyote (*Canis latrans*). Gorsuch (1934) working with the more abundant Gambel Quail (*Lophortyx gambelii*) in what might be considered excellent coyote habitat found coyotes did not deliberately prey on Gambel Quail and were not believed to be of importance in reducing quail numbers. Predation on Montezuma Quail is even more unlikely because of fewer quail and fewer coyotes in the latter's range.

In general, there is no evidence that these quail suffer excessive loss through predation. Similarly there is no record of diseased birds or losses that could be attributed to a pathogen.

Hunting is a negligible cause of mortality in most of the range of Montezuma Quail. The bird is protected in the southwestern United States and is not large enough or abundant enough to attract the attention of many native hunters in México. The species is hunted to a limited extent by sportsmen of Mexico City and some other urban centers. There are statements in the literature that hunting is a critical factor. López and López (1911) described the habit of the coveys of scattering after a short flight and holding well for single shooting (with dogs) and because of this behavior they asserted that "it is favored by hunters and . . . is growing steadily scarcer" (our translation). Vorhies (1928) attributed the scarcity of the bird in Arizona to past as well as current hunting. In our opinion hunting has no bearing whatsoever on populations. In point of fact, the Montezuma Quail is a fine game bird and its hunting, where it is reasonably numerous in México, should be encouraged.

SUMMARY

The Montezuma Quail is a common resident of the Mexican highlands, specifically of the pine-oak vegetation zone. The association between this quail and the pine-oak forest is so universal that the bird may be considered an avian indicator of the type.

Within the pine-oak zone, the highest quail populations are found in ungrazed areas where there occur many bulb-bearing forbs and sedges in the understory. In the dry season Montezuma Quail feed heavily on bulbs which they dig from the ground. Grazing eliminates these plants and hence eliminates the quail.

Winter coveys of Montezuma Quail are small (7.6 birds) and seem to be family units. Pairing occurs in April and May, nesting from May to July. The period of incubation is 25 to 26 days. Most young hatch in July and August when the summer rains

have induced plant growth and there is an abundance of insects on which chicks and adults feed. Both parents help rear the chicks. By October the young are essentially grown and coveys are established on winter ranges. At this time the birds have shifted back to bulbs as the staple diet.

Populations vary in density from place to place according to the quality of the habitat. They also vary locally from year to year with effects of weather. Either cold, snowy winters or dry summers will suppress populations.

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OBSERVATIONS ON SEA BIRDS IN THE TROPICAL PACIFIC

By JOSEPH E. KING and ROBERT L. PYLE

The Pacific Oceanic Fishery Investigations (POFI) of the United States Fish and Wildlife Service, with headquarters in Honolulu, is engaged in a program of oceanographic and fisheries research in the central Pacific. In the period from September 23 to December 17, 1955, the POFI vessel *Hugh M. Smith* made an 86-day, 13,800-mile cruise which afforded the authors an unusual opportunity to observe the sea birds in the equatorial region of the eastern and central Pacific, an area which is not frequently visited by ornithologists.

This cruise of the *Smith*, forming a part of the "Eastropic" expedition in which several research agencies collaborated, followed the route shown in figure 1. The primary objective of the cruise was to obtain information on east-west gradients in water temperature, salinity, chemical nutrients, and abundance of plankton and forage organisms in relation to the current system.

It is standard procedure on POFI cruises for the crewmen standing wheelwatch to record all bird flocks and scattered birds sighted each day. These observations are not usually to the species level, however. In addition to this watch by the crewmen, King maintained throughout the cruise a 1-hour watch each day between 4 and 5 p.m., during which period an effort was made to count and identify to species all birds sighted. On the westbound leg of the cruise, a similar watch was performed each morning, usually at 6 to 7 a.m., by Pyle, who joined the expedition at Manzanillo. The results of these observations, with particular emphasis on the variations in abundance and distribution of the sea birds in respect to the equatorial current system, and an annotated list of the species sighted, are the subject of this report.

In our record keeping we tried to distinguish between scattered birds and birds in flocks. Five or more birds traveling or feeding together as an aggregate were considered a flock. The number of flocks sighted each day and the number (frequently estimated) of individuals in each flock are given in table 1. It is evident from the table that bird flocks varying greatly in number of individuals were observed on less than half the days of the cruise, whereas scattered birds were sighted every day. Because of the small number of bird flocks and their distorting effect on the daily averages, they have been omitted from the detailed analysis in the sections to follow. The average number of scattered birds seen per hour for each day (table 1, fig. 1) was obtained by combining the number sighted by the wheelwatch in 9 to 12 hours of observation with the number sighted by Pyle in one hour and the number sighted by King in one hour, then dividing by the total hours put in each day. We recognize that the "average number" calculated in this manner is hardly an ideal statistic, but it does provide an index to the day-to-day variation in bird abundance and it seemed to be the best way to combine and utilize the available data. All observations made within one day's running (approximately 200 miles) of the Mexican coast or of the different island groups were omitted from the calculations although the species were recorded. Close to land the numbers of birds increased so markedly that an accurate count was impossible.

The identifications are based almost entirely on careful sight records, although representatives of several species came aboard the vessel and were examined in the hand. These included: Wedge-tailed Shearwater, Christmas Shearwater, Black-vented Shearwater, Tahiti Petrel, Hawaiian Petrel, White-throated Storm-petrel, Madeiran Storm-petrel, Leach Storm-petrel, and Sooty Tern. The crewmen were all skilled fishermen who were well acquainted with the common species and possessed remarkable ability to sight birds at considerable distances. There was doubtless some individual variation in the

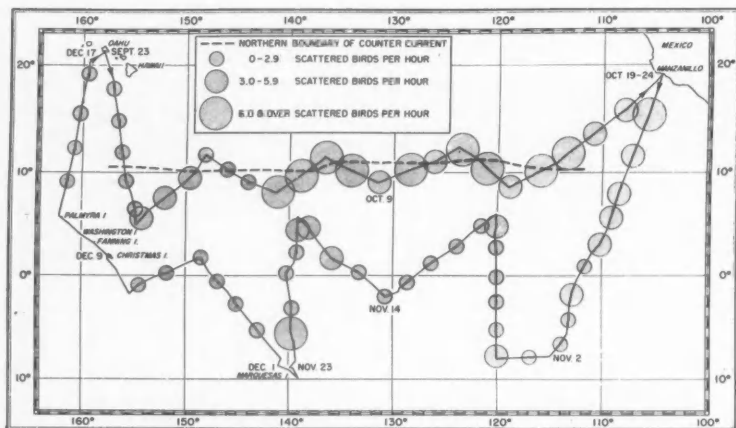


Fig. 1. Track of the M/V *Hugh M. Smith* on the "Eastropic" cruise showing variations in number of scattered birds seen per hour for each day of observation. Sightings by King, Pyle, and the wheelwatch were combined and the resulting average figures grouped into three classes: 0 to 2.9, 3.0 to 5.9, and 6.0 birds and over. The value for each day is plotted at the noon position. All observations within one day's run (about 200 miles) of land were omitted.

Table 1

Average Numbers of Scattered Birds and Birds in Flocks Sighted Each Day of the "Eastropic" Cruise of the *Hugh H. Smith*, Omitting All Observations within One Day's Run (about 200 Miles) of Land

Date 1955	Noon position		Scattered birds			Total, av. No./hr. ⁴	Birds in flocks	
	Latitude	Longitude	Morning watch, 1 hr. ¹	Afternoon watch, 1 hr. ²	Wheel- watch, av. No./hr. ³		No. of flocks/ day ⁴	No. of birds in flocks
9/24	17°49'N	157°09'W	....	....	1.0	1.0	0	....
9/25	15°56'N	156°37'W	....	7	1.0	1.5	0	....
9/26	11°56'N	156°12'W	....	....	2.4	2.4	6	309
9/27	09°10'N	155°47'W	....	1	1.5	1.5	0	....
9/28	06°33'N	154°48'W	....	....	1.8	1.8	0	....
9/29	05°31'N	154°13'W	....	10	2.8	3.4	1	25
9/30	07°28'N	151°58'W	....	11	3.5	4.1	5	206
10/1	09°24'N	149°34'W	....	11	4.8	5.4	0	....
10/2	11°38'N	148°04'W	....	5	0.8	1.2	0	....
10/3	10°15'N	145°57'W	....	5	1.0	1.4	0	....
10/4	09°04'N	143°49'W	....	5	2.1	2.4	0	....
10/5	08°00'N	141°10'W	....	4	6.7	6.4	0	....
10/6	09°43'N	138°51'W	....	29	6.3	8.4	3	80
10/7	11°14'N	136°30'W	....	12	5.9	6.5	0	....
10/8	10°09'N	133°59'W	....	15	6.3	7.1	3	175
10/9	09°01'N	131°21'W	....	18	2.3	3.7	2	62
10/10	10°12'N	128°13'W	....	6	7.8	7.4	2	50
10/11	11°00'N	126°02'W	....	9	3.4	3.9	1	50
10/12	12°08'N	123°34'W	....	9	7.7	7.7	1	30
10/13	10°18'N	121°04'W	....	12	7.1	7.5	2	65
10/14	08°36'N	118°50'W	....	6	3.9	4.1	0	....
10/15	10°05'N	115°51'W	....	14	6.9	7.5	1	30
10/16	11°40'N	113°25'W	....	19	10.0	10.5	1	8
10/17	13°36'N	110°51'W	....	6	3.2	3.4	1	20

Date 1955	Noon position Latitude Longitude		Scattered birds			Total, av. No./hr. ⁴	Birds in flocks	
			Morning watch, 1 hr. ¹	Afternoon watch, 1 hr. ²	Wheel- watch, av. No./hr. ³		No. of flocks/ day ⁴	No. of birds in flocks
10/18	15°46'N	107°57'W	----	2	4.2	3.0	1	35
10/19-24	Mexico							
10/25	15°16'N	105°44'W	4	33	7.0	8.6	1	150
10/26	11°33'N	107°08'W	8	20	4.1	5.2	3	18
10/27	07°58'N	108°25'W	14	8	6.0	5.9	0	----
10/28	05°41'N	109°06'W	19	4	4.3	5.6	0	----
10/29	03°04'N	110°10'W	4	4	3.3	3.4	1	45
10/30	00°59'N	111°32'W	0	4	1.2	1.4	0	----
10/31	01°40'S	112°52'W	15	0	4.0	4.6	0	----
11/1	04°25'S	112°50'W	----	5	1.6	2.0	0	----
11/2	06°46'S	113°54'W	1	0	1.8	1.6	0	----
11/3	07°53'S	116°50'W	0	4	1.1	1.4	0	----
11/4	07°46'S	120°00'W	7	16	2.9	4.5	2	30
11/5	05°14'S	120°00'W	3	3	1.3	1.6	0	----
11/6	02°38'S	120°01'W	1	1	1.8	1.6	1	25
11/7	00°03'S	119°52'W	1	0	2.1	1.8	0	----
11/8	02°50'N	120°00'W	1	10	1.0	1.8	1	17
11/9	04°55'N	120°05'W	18	10	2.0	4.2	0	----
11/10	04°56'N	121°26'W	0	0	1.3	1.1	0	----
11/11	02°52'N	123°50'W	0	6	1.8	2.0	0	----
11/12	01°11'N	126°23'W	0	0	0.6	0.5	0	----
11/13	00°32'S	128°40'W	4	6	2.1	2.6	1	5
11/14	02°02'S	130°46'W	3	4	1.2	1.6	0	----
11/15	00°14'N	133°12'W	0	0	1.0	0.8	0	----
11/16	01°44'N	135°50'W	4	4	4.9	4.7	0	----
11/17	04°48'N	138°16'W	2	3	3.6	3.4	0	----
11/18	04°26'N	139°09'W	0	8	6.1	5.7	1	50
11/19	02°13'N	139°11'W	0	6	1.2	1.5	0	----
11/20	00°14'N	140°10'W	2	2	0.6	0.8	0	----
11/21	03°02'S	139°44'W	1	0	1.0	0.9	0	----
11/22	05°36'S	139°50'W	1	4	8.4	7.4	1	16
11/23-12/1	Marquesas Islands							
12/2	05°13'S	143°01'W	4	2	1.0	1.3	3	113
12/3	02°40'S	145°04'W	2	3	0.7	1.0	0	----
12/4	00°27'S	146°54'W	2	0	0.3	0.4	0	----
12/5	01°42'N	148°38'W	2	1	0.9	1.0	1	25
12/6	00°17'N	151°45'W	4	1	1.3	1.5	1	80
12/7	00°51'S	154°30'W	2	1	1.2	1.2	0	----
12/8-12	Line Islands							
12/13	09°02'N	161°23'W	1	1	0.5	0.5	0	----
12/14	12°18'N	160°43'W	0	1	0.5	0.5	0	----
12/15	15°38'N	160°13'W	2	0	0.4	0.4	0	----
12/16	19°12'N	159°23'W	1	0	0.1	0.1	0	----

¹ By R. Pyle, usually at 6:00 to 7:00 a.m.² By J. King, usually at 4:00 to 5:00 p.m.³ With observations throughout a 9- to 12-hour day.⁴ Includes sightings by the wheel-watch, R. Pyle and J. King.

effort they expended and in their interest in the project, but the watch was rotated each day so that differences among observers probably did not greatly influence the results. The bulk of the time spent on these observations was contributed by the crewmen, and we wish to acknowledge and thank them for their assistance.

The most important sources of error in our records, we believe, are those related to the difficulties of accurately observing and identifying birds from a small vessel on the open sea. Many of the birds do not follow the ship but remain at a distance; they are usually seen in fast flight and rarely resting on the surface; the vessel is always rolling

and pitching to some degree, making it difficult to hold binoculars steady; and individuals of some species that have the habit of following vessels may have been counted more than once. Our observations were made from the upper deck of the vessel where visibility was excellent and a bird in flight could be followed through 360° if desired. Also, weather conditions were generally good throughout the cruise; on only a few days did heavy rain or rough seas interfere to any extent. Our data provide some measure of the variation in bird sightings in relation to sea surface and amount of cloud cover.

The most widely used reference in making identifications was Alexander (1954). In the eastern Pacific the publications of Murphy (1936), Peterson (1941), and Blake (1953) were also helpful.

Previous records, principally on the occurrence and distribution of sea birds in the central Pacific, have been provided by Murphy (1924, 1928, 1929), Jespersen (1932-33), Fleming (1950), and Macdonald and Lawford (1954). The nearest approach to an analysis of the bird populations and their relation to environmental factors is that of Murphy and Ikehara (1955) for the mid-central Pacific. No quantitative studies as comprehensive as those of Jespersen (1930) and Moore (1951) on sea birds of the North Atlantic, have been made in the Pacific, to our knowledge. The present study does not change this situation to any great degree but does provide some information on variations in the numbers of birds as related to the current system and to certain other features of the environment.

DESCRIPTION OF THE ENVIRONMENT

The general pattern of the Pacific equatorial current system has been described by Sverdrup, Johnson, and Fleming (1942:708-712). In brief, the major surface currents of this region are the North and South Equatorial Currents flowing toward the west, and the eastward-flowing Equatorial Countercurrent lying in between. Although the boundaries of the Countercurrent (CC) may vary meridionally with longitude and season, its southern and northern boundaries ordinarily occur near 5°N and 10°N latitude in the eastern central Pacific. The South Equatorial Current (SEC) is therefore on both sides of the Equator while the North Equatorial Current (NEC) is confined entirely to the Northern Hemisphere. The general features outlined here apply principally to the central Pacific and may not hold for the extreme eastern part of the region. A detailed study of the oceanographic data from this area is presently being made by POFI and other research agencies.

The Equator is the site of upwelling resulting from divergence of the surface waters. The newly upwelled water is high in nutrients and provides a favorable environment for the growth of plankton. Convergence and sinking of the surface waters, occurring between about 2°N latitude and the southern boundary of the CC, may tend to concentrate the plankton into a rich pasturage for forage organisms, which in turn serve as food for the larger fishes such as the tunas and also for the sea birds.

Enrichment of the surface water by an entirely different mechanism is thought to occur along the northern boundary of the CC. In the eastern and central Pacific this boundary region is an area of shallow thermocline with high-phosphate water occurring within the photosynthetic zone and within the reach of wind-induced turbulence. To the westward the thermocline deepens, reducing the likelihood of enrichment of the surface layer through this combination of factors.

VARIATIONS

Current system.—For purposes of examining variations in bird abundance as related to the current system, we use the six latitudinal subdivisions of the area established by

King and Hida (MS). These are based on natural features and are defined as follows: (1) the NEC from about 20°N latitude to the northern boundary of the CC; (2) the CC with its boundaries being determined at the time of each crossing from vertical temperature sections; (3) a zone of convergence in the SEC extending from the southern boundary of the CC to 1½°N latitude; (4) a zone of divergence and upwelling in the SEC along the Equator from 1½°N to 1½°S latitude; (5) the SEC from 1½°S to 5°S latitude; and (6) the SEC from 5°S to about 14°S latitude. Since special effort was spent on our cruise to investigate the northern boundary of the CC, we established a seventh subdivision of 2 degrees of latitude extending from 1 degree north of the current boundary to 1 degree south of the boundary. The latitudinal limits of these seven zones are shown in figure 2.

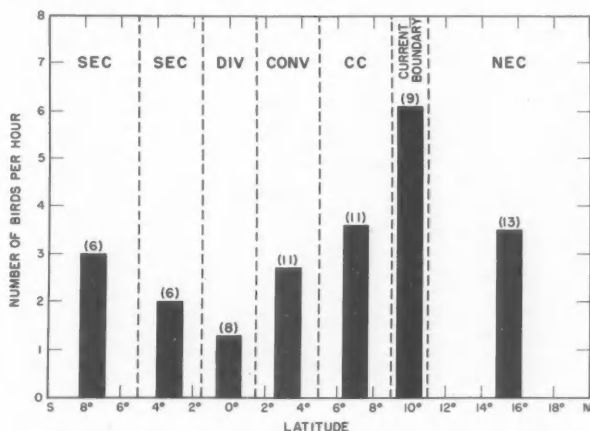


Fig. 2. Variation in numbers of scattered birds sighted per hour of observation in relation to the current system. All sightings within one day's run (about 200 miles) of land were omitted. Number of days on which each average value is based is shown in parentheses.

When the numbers of scattered birds are combined in accordance with these subdivisions of the current system, omitting all sightings within one day's run of land and disregarding differences associated with longitude, we find the largest number of birds occurring along the northern boundary of the Countercurrent and the least number in the zone of divergence on the Equator (fig. 2). It is evident from table 1 that the number of bird flocks was also greater in the region of the Countercurrent than near the Equator; for example on the eastbound leg, 30 bird flocks including a total of about 1145 birds were seen on 25 days (1.2 flocks or 38 birds per day) whereas on the westbound leg south of the CC (south of 5°N) only 13 flocks including about 406 birds were seen on 31 days (0.4 flocks or 13 birds per day). This distribution is generally similar to that described by Murphy and Ikehara (1955, fig. 7) for the central Pacific and also closely parallels the abundance of bigeye tuna (*Parathunnus sibi*) as determined from POFI longline fishing, but is inversely correlated (King and Hida, MS) with the catch of yellowfin tuna (*Neothunnus macropterus*). Reasons for these apparent relationships between birds and subsurface fish are obscure and will not be discussed further in this paper.

In the eastern Pacific (120°W – 140°W longitude) the distribution of zooplankton shows a double peak, being high both at the Equator and at the northern boundary of the CC (King and Hida, MS). Of these two "enriched" areas the sea birds, as well as the bigeye tuna, seem to find better foraging conditions at the northern boundary of the CC.

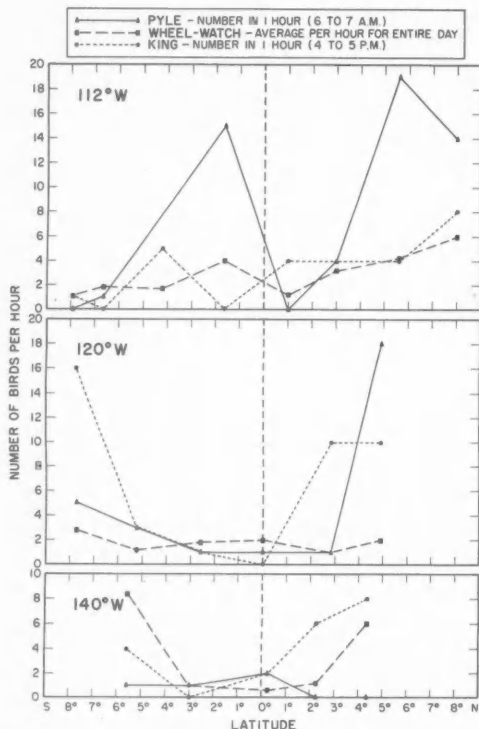


Fig. 3. Variation in numbers of scattered birds comparing the sightings of Pyle, King, and the wheelwatch on three north-south section lines crossing the Equator on longitude 112° , 120° , and 140°W , with the values for each day's observations plotted on the noon position. All sightings within one day's run (about 200 miles) of land were omitted.

Figure 3 shows the latitudinal distribution of scattered birds on the three long station lines crossing the Equator on 112° , 120° , and 140°W longitude. Despite the considerable variation among observers there is evidence of reduced numbers on the Equator and increases to the north and south.

Longitude.—When numbers of scattered birds are combined by 10-degree intervals of longitude, disregarding differences associated with latitude, we obtain a picture (fig. 4) of generally increasing abundance from west to east, with peaks at 140°W and at 110°W longitude. This distribution is probably influenced by the occurrence of the Marquesas

Islands at about 10°S latitude, 140°W longitude and the nearness of the Mexican coast on the east, even though observations within one day's run of land were omitted. The generally low abundance west of 140°W longitude and the increase in numbers along the northern boundary of the CC east of 140°W longitude are clearly shown in figure 1.

There was apparently little variation from east to west in number of bird flocks. The highest average number of flocks (1.1) and the largest average number of birds in flocks (43) sighted per day was recorded for 130°W longitude.

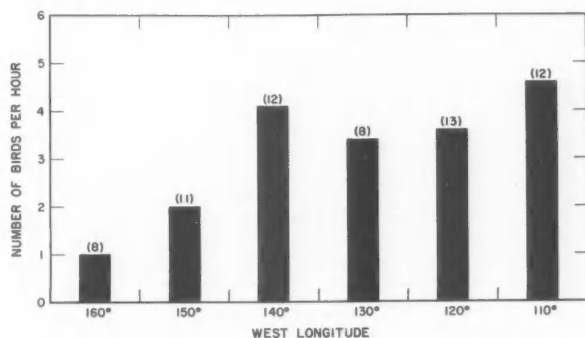


Fig. 4. East-west variation in numbers of scattered birds by 10-degree intervals of longitude. Number of days on which each average value is based is shown in parentheses.

Diurnal.—Our data provide some indication that, during daylight hours, scattered birds were most numerous in the late afternoon period. Numbers of scattered birds sighted by the wheelwatch for each hour from dawn to dusk (6 a.m. to 7 p.m.), and averaged for the entire cruise, but omitting all observations within one day's run of land areas, are shown in figure 5. As the plankton work was conducted each day between 9 and 11 a.m., the bird observations during this period were few and probably not of

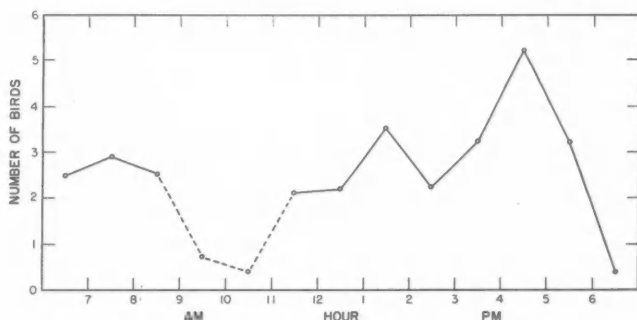


Fig. 5. Variation in number of scattered birds from dawn to dusk as sighted by the wheelwatch. Sightings during 9 and 10 a.m. hours are probably not quantitative. All observations within one day's run (about 200 miles) of land were omitted.

quantitative nature. The peak between 4 and 5 p.m. seems significant although it is partly explained by the presence on the bridge of two observers who were of some assistance to each other in locating birds.

Further evidence of a slightly greater number of scattered birds in flight in the late afternoon, as compared with the early morning, is given by the average sightings of the two special observers on the westbound leg. In the afternoon watch King sighted an average of 4.5 birds per hour whereas in the morning watch Pyle sighted an average of 3.5 per hour. The number of bird flocks varied irregularly with the hour of day, but 36 flocks were sighted between 12 noon and 6 p.m. as compared with 11 flocks between 6 a.m. and 12 noon.

Miscellaneous.—Two factors which may affect the observer's ability to see birds at sea are amount of overcast or cloud cover and the nature of the sea surface. On a clear, calm day bird flocks can be seen with fair regularity at two to three miles with the unaided eye and single birds at one to two miles. With reduction in light through cloudiness and with higher waves and swell to hide low-flying birds it is reasonable to suppose that fewer birds will be seen than under ideal conditions, assuming their actual numbers remain the same.

Although our data are perhaps not sufficient to provide definite conclusions, it would appear from table 2 that increasing cloudiness had no effect on the numbers of scattered birds sighted. Table 3 indicates, on the other hand, that increasing wave height resulted in fewer birds seen. We have no way of knowing, of course, if the true abundance of birds in flight changed with changes in sea surface.

Table 2

Variation in Number of Scattered Birds Sighted in Relation to Amount of Cloud Cover¹

	Cloud cover, in eighths		
	0-2	3-5	6-8
Average number of birds/hour	5.4	4.3	5.9
Number of hours observed	38	18	46

¹ Based on observations by R. Pyle and J. King during early morning and late afternoon watches.

It is believed that sharp temperature discontinuities or "fronts" occurring in the ocean surface layer may have a concentrating effect on plankton, the basic food in the sea, and consequently influence the distribution of other marine animals. On the westbound leg of our cruise the ship's thermograph (not operating on the eastbound leg of the cruise) recorded 17 fronts with temperature differences across the front ranging from $\frac{1}{2}^{\circ}$ to 4° F. When the positions of these sharp temperature breaks were plotted on a chart similar to figure 1, together with numbers of scattered birds and bird flocks, we could see no evidence of a causal relationship. In only four instances were bird flocks sighted either working over a front or within an hour's run of the temperature discontinuity. We conclude, therefore, that on this cruise the phenomenon had little or no influence on bird distribution or overall bird abundance.

Table 3

Variation in Number of Scattered Birds Sighted in Relation to Sea Surface¹

	Sea surface, height of waves, in feet			
	< 1	1-3	3-5	5-8
Average number of birds/hour	9.3	6.4	5.0	3.1
Number of hours observed	3	36	55	8

¹ Based on observations by R. Pyle and J. King during early morning and late afternoon watches.

ANNOTATED LIST OF SPECIES

The following species of birds were recorded at sea during the cruise. In many instances records are given by date: the approximate coordinates of these observations may be determined from figure 1 and table 1. Peters (1931, 1934) has been followed in respect to scientific names and order of listing; common names are as given in Alexander (1954).

Puffinus pacificus. Wedge-tailed Shearwater. Recorded on 10 days in the course of the eastbound leg, including a flock of 20 on October 6. Individual birds came aboard the ship on October 4 and 13. A total of eight was seen on October 24 just off Manzanillo, and one was recorded on October 27.

Puffinus griseus. Sooty Shearwater. This completely dark shearwater replaced the very similar Christmas Shearwater in the northeastern portion of the cruise track. It was recorded on October 13, 14, and 15 near 10°N, and again on October 24, 25, and 26, all in the general area southwest of Manzanillo. One bird was seen on November 4 near 7°S, 120°W.

Puffinus nativitatis. Christmas Shearwater. Observed on September 29 and 30 and daily from October 5 to 10 between 141° and 128°W. It was not identified again until November 13 when we had reached 129°W on the west-bound leg. Thereafter it was seen irregularly in the general area north of the Marquesas Islands, including one flock of about 20 recorded on November 18. It became far more abundant near and just north of Christmas Island and was last recorded on December 12 just north of Palmyra Island. On Motu Tabu in Christmas Island lagoon, this species was observed nesting in numbers. Many of the shallow nesting burrows or depressions contained an egg, and several half-grown chicks were seen.

Puffinus opisthomelas. Black-vented Shearwater. First recorded on October 4 when one came aboard the ship. Eight were observed on October 6, and thereafter occasional individuals were seen until October 26, all north of 9°N.

Puffinus assimilis. Dusky Shearwater. Recorded on October 24 and 25, just off Manzanillo, including a flock of about 24 individuals on the 24th, most of which were identified as this form.

Puffinus lherminieri. Audubon Shearwater. Recorded on November 23 and 25 and December 1 in the immediate vicinity of the Marquesas Islands. Several were seen on December 9 within a few miles of Christmas Island.

Pterodroma rostrata. Tahiti Petrel. On November 29 some Marquesan boys brought a bird of this species to the ship while at anchor in Taa Huku Bay, Hiva Oa Island. They stated it had been taken from a burrow on Hiva Oa that same morning. It was identified as this species, rather than *P. alba*, by the large bill, the complete absence of any white flecking on the throat, and by the entirely black outer toe. The bird was photographed and later released. Another bird, probably of this species, but possibly *P. alba*, was seen from the ship on November 30 while still close to Hiva Oa.

Pterodroma alba. Phoenix Petrel. Recorded on September 29 near 6°N, 154°W, and again on December 5 near 1°N, 149°W. The species was abundant on and near Christmas Island, and it was seen frequently in flight over both the lagoon and the land areas of the atoll. On Motu Tabu, Christmas Island, many were observed in and near burrows, and although most nests contained a single egg, no chicks were found. No birds were seen over the ocean out of sight of the atoll, except the two already noted.

Pterodroma phillipii. Kermadec Petrel. Recorded in the course of the eastbound leg on October 5, 7, and 9 near 10°N between 141° and 131°W. Three birds, probably of this species, were seen November 4 near 7°S, 120°W. Distinguished from the Herald Petrel (*P. heraldica*) by the larger body size and the distinct white area toward the tip of the under surface of the wings.

Pterodroma phaeopygia. Hawaiian Petrel. This bird was observed more frequently throughout the cruise than any other species. It was first seen September 27 near 9°N, 155°W and from then until October 30 it was recorded on 24 out of 28 days at sea. Usually about one to three individuals were seen each day, although unusually large counts of nine birds each were noted on October 16, 26, and 28. It was not seen for four consecutive days (October 31 to November 3) at the extreme south-east portion of the cruise track, but scattered birds were seen again on 13 of the next 20 days, in equatorial waters between 120° and 140°W. This included three birds recorded November 22 on 140°W near 6°S. Most of a flock of 25 shearwaters seen on November 6 were thought to have been

this species. Single birds were recorded on 4 of the 8 days between the Marquesas and Christmas Island, and one was seen on December 11 near Washington Island. This species is reported to breed only in Hawaii and the Galapagos Islands (Richardson and Woodside, 1954). However, we failed to record it in the Hawaiian area and it was not seen as we neared the Galapagos Islands.

Pterodroma cookii. Cook Petrel. Small, fast-flying, white-breasted petrels were seen on 19 days in the course of the westbound leg, between Manzanillo and Christmas Island. Fifteen birds were counted on October 25, just off the Mexican coast, but usually there were not more than one or two individuals sighted per day. They were also recorded on four days on the eastbound leg (October 1, 3, 9, and 12). Most of these were thought to be *P. cookii* since the crown appeared gray, concolor with the gray of the upper back, as described by Murphy (1936:720). On the basis of the known range (Murphy, 1929; Jespersen, 1932-33) of these small "gadfly" petrels, many of the examples sighted may have been the Gould Petrel.

Pterodroma leucoptera. Gould Petrel. On the eastbound leg of the cruise this petrel was recorded on September 27 and 30 near 155°W and 151°W, respectively, between 8°N and 9°N.

Bulweria bulwerii. Bulwer Petrel. Fairly abundant around the Marquesas Islands. Many were seen while traveling between islands, but only one was recorded away from the island group; this was seen on November 18 near 4°N, 139°W.

Fregata grallaria. White-bellied Storm-petrel. Three birds seen on November 3 and single birds observed on November 17 and December 1.

Nesofregata albigularis. White-throated Storm-petrel. One bird observed on October 6 near 10°N, 138°W. The species was not sighted again until we reached the Marquesas, where single birds were observed on three days. On December 1, one came aboard and was banded and released. One was seen on December 8 as we approached Christmas Island, and several were observed on December 9 over Christmas Island lagoon and also in the ocean nearby.

Oceanodroma castro. Madeiran Storm-petrel. *Oceanodroma leucorhoa*. Leach Storm-petrel. Small, white-rumped petrels were seen east of 144°W almost daily from October 4 to November 20. One bird came aboard the vessel on October 6 and was tentatively identified in the hand as *O. castro*. They were not recorded on November 3, 4, or 5 at the extreme southeast portion of the cruise track, but otherwise during this period we never failed to sight them for more than one day consecutively. From October 31 to November 19, on both sides of the Equator between 113°W and 140°W, a total of 11 storm-petrels came aboard the ship during the evening hours. These birds all belonged to the same species. Seven were captured, banded, and released, and one was preserved as a specimen which was later sent to the United States National Museum and there identified as *O. leucorhoa*. After leaving the Marquesas, storm-petrels were recorded only on December 6, 7, and 8 southeast of Christmas Island, and on December 11 between Christmas and Palmyra. Most of the storm-petrels observed from the vessel during daylight hours appeared to have a broad rectangular rump patch similar to the example of *O. castro* which was examined in the hand. A few were observed to have markedly forked tails.

Oceanodroma melania. Black Storm-petrel. Seen only close to the Mexican coast. One recorded on October 19 and three together on October 24.

Phaethon aethereus. Red-billed Tropic-bird. Seen on October 19 and 24 close to the Mexican coast.

Phaethon rubricauda. Red-tailed Tropic-bird. The only species of tropic-bird regularly seen more than 200 miles from land. Infrequently sighted on the eastbound leg to the east of 150°W, but after leaving Manzanillo individuals and pairs were seen frequently from October 26 to November 20, and again from December 4 to 15. Not recorded in or near the Marquesas group. On Motu Tabu, in Christmas Island lagoon, about ten nests were located, each containing an egg or a chick. The chicks were in all stages from very young to nearly full grown.

Some individuals in the open ocean either lacked the long central tail feathers altogether, or had two very small white feathers protruding from the tail. While these individuals did not have the typical mottled pattern of young birds, they sometimes appeared dingy on the back and usually the bill was darker than normal. They were usually seen in the company of a bird in typical adult plumage.

Phaethon lepturus. White-tailed Tropic-bird. Recorded near the Hawaiian Islands on September 24 and December 15 and 16. Common in and around the Marquesas Islands.

Fregata magnificens. Magnificent Frigate-bird. Common in Manzanillo harbor, and individuals

seen at sea on October 24 and 25 were probably this species. A flight of six birds seen on October 29 was also presumed to be this species.

Fregata minor. Great Frigate-bird. Common in and around Christmas Island.

Fregata ariel. Lesser Frigate-bird. Frigate birds were fairly common in the Marquesas Islands, and every adult male definitely identified belonged to this species.

Pelecanus occidentalis. Brown Pelican. Common in and near Manzanillo.

Sula nebouxii. Blue-footed Booby. Several seen on November 19 just off the Mexican coast, but they were much fewer in number than *S. leucogaster*.

Sula dactylatra. Blue-faced Booby. Four birds recorded on September 28 and 29 between 5°N and 3°N, 110°W. Not definitely identified again until December 8 when we were approaching Christmas Island. Many were seen on and around Christmas Island on December 9, and several were recorded over the ocean between Christmas and Palmyra. One was seen on December 14 near 12°N, 160°W.

Sula sula. Red-footed Booby. Common around the Marquesas Islands, where all individuals sighted were in the brown phase. At Christmas Island, most of the birds had brown wings and back, but were otherwise white. Birds seen between Christmas and Palmyra were in the white phase typical of the Hawaiian Islands.

Sula leucogaster. Brown Booby. Abundant close to the Mexican coast and also around the Marquesas Islands. Several were seen at Christmas Island. None recorded at sea more than 100 miles from land.

Pluvialis dominica. Golden Plover. One observed in flight at sea on September 28.

Arenaria interpres. Ruddy Turnstone. On October 3, near 10°N, 146°W one circled the ship for about 10 minutes. A flock was observed on October 19 near the Mexican coast.

Phalaropus fulicarius. Red Phalarope. Four unidentified phalaropes were recorded on October 19 just off the Mexican coast, and four more were observed in the same general area on October 24. Again, four were seen on November 8, near 4°N, 120°W in association with a marked convergence or "front" in the upper layer of the ocean. On the following morning, still in the convergence zone, an individual phalarope was observed very close to the ship and identified as this species.

Catharacta skua. Great Skua. A bird identified as this species passed close by the ship on November 13, near 1°S, 129°W.

Stercorarius pomarinus. Pomarine Jaeger. Jaegers probably of this species were recorded occasionally on all portions of the cruise track, between September 29 and December 6.

Larus sp. One gull, possibly *L. californicus* in second-year plumage, followed the ship briefly on October 13, more than 1000 miles from the Mexican coast.

Sterna sp. Two or three large flocks of medium-sized white terns with light gray mantles were observed together on October 24, about 50 miles off the Mexican coast.

Sterna fuscata. Sooty Tern. Observed far more frequently than any other tern. Recorded on only four days on the eastbound leg, but abundant close to the Mexican coast. Between Manzanillo and the Marquesas it was seen occasionally, including a flock of 25 to 30 birds on November 4 and a flock of 14 birds on November 8 in association with a convergence front in the upper layers of the ocean. The species was abundant in and around the Marquesas and was observed daily at sea between the Marquesas and Palmyra Island. It was not seen after December 11.

Thalasseus bergii. Crested Tern. Nine individuals recorded on Christmas Island, on the same sand bar at the lagoon entrance where King (1955) found them in 1953.

Procelsterna cerulea. Blue-gray Noddy. Common in and near the Marquesas and Christmas Island. On Motu Tabu in Christmas Island lagoon several eggs were found.

Anous stolidus. Common Noddy. Several birds of this species were seen in the Marquesas Islands and on Christmas Island. In addition, two birds were recorded at sea on October 10 near 10°N, 128°W.

Anous minutus. White-capped Noddy. Common in and near the Marquesas and Christmas Island. On Motu Tabu in Christmas Island lagoon nesting was nearly completed and only a few nearly full grown young were seen.

Gygis alba. White Tern. Abundant in and around the Marquesas Islands. Although many were observed on Nukuhiva Island, none was captured or collected so that the form *G. a. microrhyncha* was not definitely identified. This species was also abundant on Christmas Island, where on Decem-

ber 9 nesting was in progress and all stages from eggs to nearly grown chicks were seen. Recorded at sea each day between Christmas and Palmyra islands.

Unidentified Ducks. A flock of about 12 ducks flying south was recorded on October 5. Individual ducks were observed on October 6, 9, 10, and 27. None was close enough to identify the species.

SUMMARY AND CONCLUSIONS

Forty species of sea birds, principally shearwaters, petrels, storm-petrels, tropic-birds, frigate-birds, boobies, and terns, were sighted on the "Eastropic" cruise of the M/V *Hugh M. Smith* to the central and eastern tropical Pacific.

Scattered sea birds were most abundant along the northern boundary of the Counter-current at about 10°N latitude. The largest numbers occurred near 110°W longitude, influenced no doubt by the nearness of the Mexican coast; and on 140°W longitude a second area of high abundance was found which may be related to the shallow thermocline, high phosphate concentrations, and rich zooplankton conditions characteristic of this region.

There is some indication that in the daylight hours scattered birds were most numerous during the late afternoon period. Increasing cloudiness had no effect on the numbers of birds sighted; but when the wave height increased, fewer birds were recorded.

There was little or no evidence that birds occurred in greater frequency in areas of marked temperature change in the sea surface.

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SUBSPECIFIC VARIATION IN WINTER POPULATIONS OF SAVANNAH SPARROWS: A STUDY IN FIELD TAXONOMY

By ROBERT A. NORRIS and GORDON L. HIGHT, JR.

In 1951 an extensive area in Aiken and Barnwell counties, South Carolina, was selected as the site for the Savannah River Plant, whose genesis and general management fall within the province of the United States Atomic Energy Commission and whose construction, maintenance, and operation are due, in the main, to the efforts of the Commission's prime contractor, E. I. du Pont de Nemours & Company. As is commonly known, the main work of the plant revolves about the production of materials used in the H-bomb and other atomic weapons; most of the critical operations, to be sure, go on behind guarded gates in restricted areas, and many details of the work are necessarily veiled in secrecy. With the establishment of the plant area, which includes some 250,000 acres, all human inhabitants sold their lands and moved out, leaving behind two or three "ghost towns," many house and farm sites, and thousands of fields on which crops had been grown. Biologists from the universities of Georgia and South Carolina were invited to conduct faunistic, floristic, and ecologic studies, under government contract (with support from the Atomic Energy Commission), in the less restricted, non-industrialized parts of the Savannah River Plant area. Among the more concerted studies undertaken have been those of old fields with stress on such matters as biomass, aspect dominance, and successional change. These were carried out principally by members of the Georgia group working under the direction of Dr. Eugene P. Odum. As was early recognized by Dr. Odum, the old fields, now permanently abandoned, offered spacious, relatively simple, rapidly changing communities ideally suited to studies in synecology.

Among the more important and influent animals inhabiting the old fields were wintering fringillids, and of these the Savannah Sparrow (*Passerculus sandwichensis*) was the most abundant species, at least in fields abandoned for three or more years. Because of its abundance and importance as a harvester of seeds, the Savannah Sparrow, among other old-field fringillids (notably the Vesper Sparrow, *Poocetes gramineus*; Grasshopper Sparrow, *Ammodramus savannarum*; and Leconte Sparrow, *Passerherbulus caudacutus*), was subjected to rather close study in the winters of 1954-55 and 1955-56. In both winters large-scale banding operations, which were promoted and supervised by Dr. Odum, were carried out by the junior author, who supplied many Japanese mist nets and did the banding. He was assisted by a number of others who helped drive sparrows into nets as well as remove them to gathering cages. Those assisting in January-February, 1955, are acknowledged by Johnston (1956); those participating in January-February, 1956, besides Dr. Odum and the authors, are acknowledged in a subsequent paragraph. The results of the banding studies, including data on repeats and returns, are presented in another paper (Hight and Odum, 1956: in press).

As marked variation in plumage was noted in the Savannah Sparrows netted in 1955, a series of 21 birds was selectively retained. These were prepared by David Johnston, identified subspecifically by Dr. John W. Aldrich, and reported on by Johnston (1956). From this endeavor the presence of five geographic races of *Passerculus sandwichensis* (*P. s. savanna*, *mediogriseus*, *labradorius*, *oblitus*, and *nevadensis*), of which three were additions to the South Carolina list, was established for the Savannah River Plant area. This qualitative determination of the subspecific makeup of the Savannah Sparrow populations, while of obvious value intrinsically, was also a necessary preliminary to the present study in which an attempt was made, in the winter of 1955-56, to identify subspecifically all the Savannah Sparrows handled (whether banded or collected), the

total numbering 559 birds. Most of the sparrows in this sample came from a single, 150-acre field, no. 3-412, where they were banded, identified, and then promptly released. The senior author is responsible for the subspecific identifications and for the analysis and interpretation of them.

It is of incidental interest that a large proportion of the Savannah Sparrows obtained in the netting operations of the first winter, as recorded by Johnston (1956), was also obtained in field 3-412. This field was especially favorable for an intensive study, for aside from being relatively large it supported, in several of its sections, unusually high densities of Savannah Sparrows (locally, as many as 20 birds per acre). In 3-412, roughly 90 per cent of the standing crop of vegetation was comprised of forbs, with the composites *Haplopappus divaricatus* and *Heterotheca subaxillaris* as outstanding dominants; and roughly 10 per cent was made up of grasses (and low-growing sedges), including strips of *Sorghum halepense*, patches of *Digitaria* and *Cynodon*, and scattered clumps and patches of *Andropogon virginicus*.

The authors are indebted to Drs. John W. Aldrich, David W. Johnston, and Eugene P. Odum, who read the manuscript and made several helpful suggestions. In 1956 we were most appreciative of aid in the field lent by the following persons: Larry D. Caldwell, Clyde E. Connell, Dr. J. Fred Denton, William A. DuPré, J. B. Gentry, J. P. Green, T. P. Haines, John B. Hatcher, Karl E. Herde, Dr. David W. Johnston, and Henry (Buddy) Robert.

PROCEDURE

Since field taxonomy, which may be defined in part as the practice of making racial identifications of living birds handled under field conditions, has not been tried heretofore in this country on any sizable scale (except by Aldrich, 1952), some explanation of both the philosophical and procedural bases of the present study should perhaps be set forth.

Series for comparison.—How, one might ask, were the races identified? A series of seasonally comparable specimens of known racial identity, including ones borrowed from Johnston's series, was available in the field so that the living birds, when securely held by their tibiotarsi, could be compared directly with skins. Although many such direct comparisons were made, it was not necessary to do this in all instances, for continual practice in handling and appraising the variant individuals resulted, as we believed, in a certain steadily improving "feeling" for subtle differences and, as we proved, in a rather high degree of "internal consistency" in that given individuals twice or thrice caught were usually given approximately the same race designations on initial and subsequent occasions.

Consistency of identifications.—In what way, exactly, was this check on consistency made? First, a grid was set up with 17 categories of possible subspecific allocations (as *labradorius*, *labradorius* > *savanna*, *savanna* > *labradorius*, etc.) arranged both vertically and horizontally. All combinations of designations, or "combinants," were then given scores, for they were designed to represent all possible combinations of kinds of discrepancies that might result from the worker's failure to allocate an individual in the same manner on different occasions. All the identical combinants (as *savanna-savanna*) were scored 100; unlike combinants pertaining to very dissimilar races (as *labradorius-mediogriseus*) were scored 0; others ranging from very similar (as *savanna-savanna* > *mediogriseus*) to rather dissimilar (as *savanna-mediogriseus*) were marked according to the nature of the difference. The more striking or irreconcilable the difference, the lower the score. Because the scoring grid or some adaptation of it might be useful to others desirous of checking their own consistency, it is herewith reproduced in its entirety (fig. 1). In general there were lower scores, or more severe penalties,

A field taxonomist, on the other hand, can easily avoid linking individual features (excepting obvious abnormalities) or band numbers with particular race designations. This is especially true when large numbers of birds are being handled in a limited period of time.

Advantage of large sample.—Even though subspecific identification under field conditions may be appreciably less accurate and hence less satisfactory than that in the museum (where the worker often has more uniform light conditions, larger series for comparison, and more time for observation, measurement, and statistical evaluation of specimens), such field identification as we undertook offered certain singular advantages, namely, that we dealt with a remarkably large sample of Savannah Sparrows in comparable plumage, in a restricted seasonal period (mostly between January 18 and February 12, 1956), from a limited wintering area (mostly from a single field, 3-412). Surely few collectors could, or would, endeavor to secure and prepare a series of comparable nature. It is therefore our view that any disadvantages inherent in the practice of field taxonomy, which admittedly may result in somewhat greater, or more frequent, errors in the ascription of *individuals*, are more than offset by the advantages inherent in the handling of a large *mass* of individuals.

Recognition of intermediates.—One further advantage in our field approach is that we were cognizant, at the outset, of the presence of racially atypical or intergradient birds. Whereas ornithologists making extensive studies of racial variation usually take into account specimens showing intermediacy (as, for example, Peters and Griscom, 1938), there is a tendency even in some monographic studies to regard geographic races—not only isolated races but also nonisolated ones which intergrade with neighboring races—as though they were more or less satisfactory entities or units, and to attach names accordingly. A number of others (for example, Rand, 1948:428) have levied similar criticism, but it nevertheless bears repeating in different words and contexts. It is all too usual for a single trinomial, designating simply one geographic race or another but giving no indication of intermediacy or other variant condition, to be applied to a specimen or series of specimens. This seems especially true of routine identifications. For instance, among 22 Savannah Sparrows taken in southern Georgia in recent years, all were ascribed by well-known taxonomists to one subspecies or another, with no suggestion of intermediacy written on any of the labels. The same was true of 15 Song Sparrows (*Melospiza melodia*). A like tendency is amply reflected in numerous state bird books in which species accounts *as such* are nonexistent; each species, haplessly, is fragmented as so many geographic race-units. There is nothing original in this criticism; it has been expressed by reviewers (as Johnston, 1955) in the past and will probably need repeating in the future. This accentuation, if not exaltation, of the geographic race at the expense of the more nearly objective species category may be found not only in state works but in many annotated lists and other writings (even the Bent life-history series); such a convention, seemingly inexorable, may well encourage the taxonomist's practice of applying neat trinomials referring to one race or another to the vast majority of specimens handled. And the converse may be true—causal relationships are not always clear. Thus, on specimen labels as well as in manifold writings, undue stress has been placed on populations conceived, at least by implication, to be essentially characteristic of given geographic races, and too little stress has been placed on those populations whose characters are intergradient or atypical in one way or another. Consequently, we believe that the actual situation is best presented by an emphasis, if not overemphasis, on the relative numbers of atypical or intermediate individuals.

Desirability of naming variants.—In designating the different sorts of variants in Savannah Sparrows, we have felt it better to use Latinized subspecies names instead of

breeding-range designations, which would offer no advantage with respect to wintering populations, or number designations, which might be less cumbersome in labeling various intergrades but which are, to our minds and others' as well, not nearly so peculiar, euphonious, or interesting as are names. As Ernst Mayr has written (*in* Sibley, 1954: 108): "With subspecies names we can designate phenotypically similar populations regardless of geography. Since it is the object of the classifier to designate such phenotypically similar populations, I don't see how, particularly in insular regions, he can do without subspecies, but he must realize at all times that the subspecies is a strictly arbitrary concept." Although we may wonder a little about the word "strictly" as used by Mayr, we are in essential agreement with the thoughts in this quotation. Despite the fact that the subspecies is anything but a neat, objective category, we recognize the value of making, as best we can, subspecific identifications of both living, banded birds and collected specimens, "regardless of geography." In so doing we learn among other things something of relative abundance, of habitat preference and other aspects of niche, of general region of birth or breeding of individuals (which might be verified by recoveries), and of approximate distances traveled as well as general directions taken by the different geographic variants.

Previous work in field taxonomy.—We should like to emphasize that some precedent for studies in field taxonomy may be found both in this country (Aldrich, 1952) and in at least one bird observatory in Britain (Williamson, 1949, 1950). It seems likely that more studies of this nature, including ones embodying such refinements as temporary anaesthetization of captive birds and extensive collection of millimetric, gravimetric, and colorimetric data, will appear in the not-distant future. In fact, Williamson and his associates (*ibid.*) have already made a significant start in this direction.

BRIEF CHARACTERIZATION OF THE RACES

Some of the more salient aspects of plumage coloration and markings, as well as of breeding distribution, are presented below. These descriptive notes are based, in the main, on Peters and Griscom (1938), Wetmore (1939, 1940), and Aldrich (1940). These workers, among others, have recognized that color characters are far more useful than linear dimensions or proportions in the identification of races of the Savannah Sparrow occurring near or along the eastern coast. For convenience in discussions beyond, we subdivide this assemblage into two groups, the light and the dark races.

Light Races

P. s. savanna.—Nova Scotia, Prince Edward Island, Magdalene islands, and part of Newfoundland. Dorsal surface: generally medium brown; feathers with dark centers and light brown edgings. Sides of head: relatively light colored, often with buffy suffusion; loreal region usually yellow or yellowish. Ventral streaks: somewhat reduced (as compared with dark races), medium to dark brown. Greater secondary coverts: medium brown.

P. s. mediogriseus.—Gaspé Peninsula south (excluding Nova Scotia) to New England and New Jersey west to Minnesota and Iowa. Dorsal surface: generally grayish brown (grayer and darker than *savanna*); feathers with dark or blackish centers, with light grayish brown or brownish gray edgings. Sides of head: colors usually of medium depth, more or less grayish brown, sometimes with ochraceous suffusion; loreal region yellow, olive-yellow, or whitish. Ventral streaks: somewhat reduced, medium to dark brown or grayish brown. Greater secondary coverts: medium grayish brown.

The population described as *mediogriseus* by Aldrich (1940) is in our opinion a valid race readily separable from *savanna*, although it might on occasion be confused with intermediates between *oblitus* and *nevadensis*, or even with *nevadensis* whose characters, as shown by specimens from the breeding ground, are not particularly constant (Peters and Griscom, 1938:469, 470).

P. s. nevadensis.—British Columbia and Alberta south to northern California, Utah, and Nevada, east to Minnesota and southern Wisconsin. Dorsal surface: pale gray; feathers with dark centers

reduced and with broad, pallid edgings. Sides of head: relatively grayish; loreal region with limited area of creamy or pale yellow. Ventral streaks: reduced, brownish or grayish brown. Greater secondary coverts: relatively pale brownish gray. (The bill of this race is relatively narrow.)

Dark Races

P. s. labradorius.—Northern Ungava south and east to Labrador and Newfoundland. Dorsal surface: very dark, black and brown; feathers with extensive black markings and rich brown edgings. Sides of head: relatively dark, especially in auricular region, with brown and buff elements noticeable; loreal region usually bright yellow. Ventral streaks: heavy, usually deep brown or black. Greater secondary coverts: dark, warm brown.

P. s. oblitus.—West side of Hudson Bay south to northern Minnesota, east to central Quebec. Dorsal surface: dark to very dark, black and gray; feathers with extensive black markings and light gray edgings. Sides of head: relatively dark, especially in auricular region, with brown and buff elements lacking; loreal region usually bright yellow. Ventral streaks: heavy, usually deep brownish black or black. Greater secondary coverts: medium or relatively light brown or grayish brown.

Table 1

Relative Abundance of Races of the Savannah Sparrow in the Savannah River Plant Area*

Time of year (1955-56)	Light races			Totals; percent- ages	Dark races		Totals; percent- ages	All races (Totals)
	<i>medio- griseus</i>	<i>savan- na</i>	<i>nevad- ensis</i>		<i>labra- dorius</i>	<i>obli- tus</i>		
Oct.	7	3	0	10 (62.5)	4	2	6 (37.5)	16
Nov.-Dec.	19	4	2	25 (89.3)	1	2	3 (10.7)	28
Jan.-Feb.	132	139	30	301 (64.5)	86	80	166 (35.5)	467
Mar.-Apr.	10	10	2	22 (50.0)	10	12	22 (50.0)	44
May 4-10	0	0	0	0 (0.0)	2	2	4 (100.0)	4
Totals	168	156	34	358	103	98	201	559
Percentages for races and groups	(30.1)	(27.9)	(6.1)	..... (64.1)	(18.4)	(17.5)	..... (35.9)	.....

* Included are 22 specimens from southern Georgia (non-selective collections).

RESULTS

Relative abundance of races.—As shown in table 1, the five subspecies reported by Johnston (1956) were again found in the winter of 1955-56. In the grand total of 559 records, 447, or 80 per cent, pertain to the January-February sample of banded birds. The remaining records refer in part to banded individuals, in part to collected specimens. Included among the specimens are 22 birds collected in southern Georgia (previously mentioned); the rest are from the Savannah River Plant area.

As is evident in table 1, the more southern, light-colored races *mediogriseus* and *savanna* were most often encountered in the old fields. Their relative prevalence is very similar, and together they comprise about 58 per cent of the total sample. The more northern, dark-colored races *labradorius* and *oblitus*, of which one was about as common as the other, together make up close to 36 per cent of the total. The westernmost race *nevadensis* contributes about 6 per cent and, as one might expect on geographic grounds, is clearly the least abundant among the five races. In aggregate the lighter colored races account for about 64 per cent of the whole sample and thus outnumber the darker races almost two to one. It is possible that the poor representation of *labradorius* and *oblitus* in the November-December subsample is misleading, for in this period among twenty-odd Savannah Sparrows closely observed with binoculars at least a third was comprised of decidedly dark individuals which, had they been collected, would probably have been referable to the *labradorius-oblitus* group.

between *oblitus* and *labradorius*, and least between *oblitus* and *mediogriseus*. We did not attempt seriously to subject our data on intermediacy or overlap to statistical treatment. Whereas it would be possible to set up linear arrangements of number sequences for races and intergrades, calculate standard deviations and other statistics, obtain *t* values or "joint nonoverlap" figures, etc., this would be of little consequence if only because the exact nature and relative degree of difference between mean values for the races would be so poorly known.

The fact that so many birds fell in the category *savanna* x *labradorius* may merely reflect our having too narrow an idea of the scope of variation in "characteristic" birds of either group. Any line or zone between the two would be more or less arbitrary, even in museum taxonomy, and probably no two workers would show it in quite the same way. Nevertheless, the apparent preponderance of these intermediates might reflect, first, what may be in point of fact an extensive zone of intergradation—in Newfoundland and perhaps elsewhere—between *savanna* and *labradorius* and, second, a stronger tendency for the northernmost and westernmost segments of the breeding population of *labradorius*, wherein dark coloration seems to reach its highest expression (cf. Wetmore, 1940:568), to travel farther south—to the gulf coast and into Florida—than do many of the more southern, less well characterized populations of this race.

Weights, measurements, and ratios.—The weights of specimens averaged about 17 grams in fall and winter, showing increases, which were apparent in all races, in late winter and spring (table 2). *Oblitus* averaged heaviest; *labradorius*, oddly enough, and *mediogriseus* were lightest; the small samples of *savanna* and *nevadensis* seemed intermediate. Actually, interracial variation in weight in the races of Savannah Sparrows under consideration is relatively low, the smallest race weighing about 92 per cent as

Table 2

Mean Weights, in Grams, of Races of the Savannah Sparrow Based on Collected Specimens

	<i>labradorius</i>	<i>oblitus</i>	<i>mediogriseus</i>	<i>savanna</i>	<i>nevadensis</i>
October	16.3 (3)*	17.0 (2)	16.8 (4)	17.8 (4)	.....
December-January	16.7 (2)	18.2 (1)	17.1 (6)	16.5 (2)	17.7 (1)
February-March-April	17.5 (3)	19.7 (8)	18.0 (6)	19.4 (5)	18.6 (1)
May	21.3 (1)	17.9 (1)	.....	.....	.....
Means by race	17.3 (9)	19.0 (12)	17.4 (16)	18.3 (11)	18.1 (2)

* Number of individuals.

much as the largest. By contrast, in Fox Sparrows (*Passerella iliaca*) the smallest race weighs only 71 per cent as much as the largest (calculation based on Amadon, 1943:173, table). The total of 50 weights for the five races of Savannah Sparrow obtained at different times in the nonbreeding season indicates an overall average of 18.0 grams (table 2).

Measurements of wing length (chord) were recorded to the nearest millimeter, mostly by the junior author, from nearly all the 447 sparrows banded in January-February, 1956. Means based on this sample are as follows: *labradorius*, 69.4; *oblitus*, 68.1; *savanna*, 67.8; *nevadensis*, 67.4; and *mediogriseus*, 67.3. In all races the range was considerable, extending from about 61-63 to 72-74 millimeters. In this sample the range, like the mean, necessarily pertains to both sexes. Compared with *oblitus*, *labradorius* seems to have a slightly longer wing, not only absolutely but also relative to body weight. Although *mediogriseus* resembles *labradorius* in its light weight, it differs from the darker race in having an appreciably smaller wing (in both length and area). Table 3 gives a more precise comparison of wing size relative to body weight. Thus, in *labradorius* the wing is large in relation to body weight, in *mediogriseus* it is small, and in

the other races intermediacy is shown. Taken as a group, the dark races, coming from high latitudes, feebly illustrate "Bergmann's rule," in which more northern races tend to be larger or heavier than more southern ones. If, however, the more northern and hence presumably more strongly migratory races have larger or longer wings relative to body weight (cf. Mayr, 1942:92), this is clearly suggested only in the comparison of *labradorius* with *mediogriseus*.

Table 3
Relative Wing Length and Wing Area in Races of the Savannah Sparrow

Ratios*	<i>labradorius</i>	<i>oblitus</i>	<i>mediogriseus</i>	<i>savanna</i>	<i>nevadensis</i>
WL/Wt	100.0 (18)**	95.0 (12)	97.0 (16)	96.3 (11)	96.6 (2)
WA/Wt	97.5 (4)	98.6 (7)	96.0 (5)	100.0 (5)	98.2 (2)
WS/Wt	100.0	98.0	97.7	99.4	98.5

* The ratio WL/Wt was derived by taking wing length, in millimeters, $\times 3.73$ over cube root of weight; for a discussion of this procedure see Amadon, 1943. The ratio WA/Wt was derived by taking square root of wing area (wing fully outstretched, traced, and measured with planimeter), in square centimeters, $\times 3.68$ over cube root of weight. In each instance the factor given in the numerator is the one required to increase the largest of the included ratios to 100 (cf. Amadon). The ratio WS/Wt is an average (unweighted) of the other two ratios, again multiplied by an appropriate numerical factor so that the largest ratio is increased to 100.

** Number of individuals.

Fall arrival and spring departure (1955-56).—In field 3-412 the first Savannah Sparrow was glimpsed in the early afternoon of September 27. An hour or so later call-notes of this species were heard. (On the 26th, when considerable time was being spent in this field, there were no signs of sparrows.) According to the senior author's notes: "Next day [the 28th] I saw 3 together in another part of this field, and I shot at one but missed. On the 29th I noted several individuals—all singles—in different parts of 3-412 Probably 4 were seen and/or heard. Stalked and followed two of these in vain, again failing to get a specimen." On October 3 and 4 three collections were made—two *oblitus* and one *labradorius*. By the 10th "Savannah Sparrows had increased somewhat . . ." and in the latter part of the month there were observations, on different days, to the effect that "although the birds have increased since the first week in October, the increase has not been very great." On November 3 the following entry was made: "Savannah Sparrows seem to be commoner and more widely distributed over the fields hereabouts than at any time before. I didn't flush many, but I was impressed with the number of *tzeets* heard over the fields and the many different spots from which they emanated. Too, as the birds have been getting more common, so they have been getting tamer—flushing close at hand and flying no great distance. They are proving to be visible on the ground now and again, contrary to the way things were earlier in the season, when the vegetation was denser and the birds more wary." (By November 7 censusing of sparrows was under way.)

Although exact quantitative data on abundance are lacking for both October and April, the decline in the sparrow population in early April seemed more abrupt than the build-up in late October. Yet some birds remained into May, and the last, a lone individual in field 9-111, was seen on May 16. As indicated in table 1, specimens obtained in May belonged to the dark races *labradorius* and *oblitus*.

Habitat and population density.—As Johnston (1956) and Hight and Odum (1956: in press) have brought out, Savannah Sparrows may occur both in old fields and in moist, marshy, shallow basins called "Carolina bays." For the general region the habitat afforded by the bays, in contrast to that in the fields, is areally restricted and is, in a sense, less satisfactory for study purposes, for the sparrows can make only limited use of these grassy expanses except at times of low water, when both the substratum and

myriads of fallen seeds become exposed. The bays were mostly filled with water in the winter of 1955-56, so in this season almost all attempts to appraise the composition and density of populations were carried out in old fields. As reported by Johnston (1956), for one Carolina bay and two rather dissimilar fields (one supporting grasses predominantly and the other composites and other forbs), there was no indication of habitat (or other) segregation of the races of Savannah Sparrow. So far as could be shown by the nettings operations in January-February, 1956, as well as by other observations, captures, and collections made in the same winter, a similar lack of segregation among the races of Savannah Sparrow again seemed to be the rule. This seemingly complete spatial overlap of the races on their wintering ground may be presumed to be selectively advantageous to the species as a whole.

In the course of the winter of 1955-56 the senior author, using two census methods found to yield closely comparable results, endeavored to work out an approximation of the overall density of Savannah Sparrows in old-field areas. One method, briefly put, involved a $1\frac{1}{3}$ -acre circular quadrat over which a rope, with one end looped over a stake, was dragged half or full circle; by whirling or whipping the rope one could cause every sparrow—with rare exception—to leave the ground (and often leave the quadrat, also, on the first flight). The other method involved a transect approximately 100 feet wide and of variable length; within this strip a certain proportion—averaging close to 50 per cent—of all sparrows on the ground would flush (the farther from the center line, along which the observer walked, the fewer the birds that would show themselves). Hence the total number of birds flushed times a correction factor (approximately two) enabled the calculation of density per acre. Tests revealed that this estimate of density was very close to that obtained from rope-dragged quadrats. Whenever there was doubt as to the identity of sparrows that flushed, the birds were pursued and flushed again; after a second or third flushing, one could usually be certain of the species. Compared with the Savannah, other sparrows including the Vesper, Grasshopper, and Leconte, were encountered in the old fields only infrequently. Savannah Sparrows in fact comprised about 75 to 80 per cent of the individuals among all birds wintering in the fields.

Table 4 contains a summary of the density of Savannah Sparrows as it was recorded in about 70 different fields. The numbers as shown for the December-early January period may be a little too high, for in this period a good deal of the censusing was done

Table 4
Density of Wintering Savannah Sparrows in Old Fields in the Savannah River Plant Area,
South Carolina

Period (1955-56)	Number acres censused	Number fields sampled	Number sample areas*	Average number Savannah Sparrows per acre
November	23.4	20	49	3.6
December-early January	71.0	35	39	6.1
Late January-February	49.5	12	38	3.6
March	53.1	26	51	3.5
May 4	27.1	1	5	0.1
Totals and grand average	224.1	(about 70)	182	3.94

* Circular quadrats and/or transects. For methods of censusing, see text.

in comparatively favorable parts of one field, 3-412, in which counts of 8 to 15 or more sparrows per acre were not uncommon. In fields of crabgrass (*Digitaria*) near Raleigh, North Carolina, similar high counts of Savannah Sparrows were made by Quay (1947: 386), who reported "an average of 67 individuals per census on plots that averaged eight acres in size [or about 8.4 birds per acre]." Quay's findings (*ibid.*: 385) not only

in areas of crabgrass but also in other types of open habitat (ranging from "Bare Field" to "Tall Weeds-Broomsedge" and "Broomsedge-Pine") suggest, however, a considerably lower overall density of Savannah Sparrows, possibly only two or three birds per acre, in what might be called an abstract, heterogeneous community of old fields in different stages of succession. It is probable that comparable heterogeneity obtained in the fields dealt with in the present study: some in 1955-56 were in their fourth year of abandonment, while some had lain fallow even longer; some were decidedly more

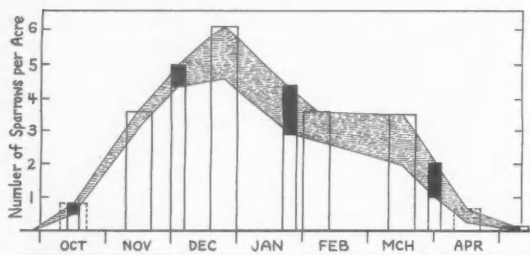


Fig. 3. Population of Savannah Sparrows in old fields in Savannah River Plant area. Height of broad bars represents density per acre, and narrow bars, with heights adjusted to curve suggested by the broad bars, show relative abundance of dark and light races (black and white areas, respectively). Hatched zone suggests relative abundance of two race groups in course of the sparrows' winter sojourn. Broad bars for October and April based only on rough estimates.

"grassy," while others were more "forby" (as determined by a semi-quantitative rating system). Details as to density of Savannah and other sparrows in relation to grassiness or forbiness of fields will be provided in a subsequent report. Even though the December-early January estimate of 6.1 birds per acre (table 4) may be somewhat high for the abstract community of fields in early winter, the grand average of approximately 3.9 Savannah Sparrows per acre is rather little affected by the high count and is deemed a close estimate of general density of the wintering population in more or less favorable habitat.

Some idea of the build-up, apparent peak, and decline of the population is conveyed in figure 3. Here we may note that shortly before the drop-off in numbers in early April, a relatively high proportion (50 per cent) of dark races was recorded; after the April drop-off there were only four specimens plus two or three close observations. These specimens, it will be recalled, pertained to examples of the dark races; the observations, also, seemed to refer to dark birds. There remains a strongly suggestive pattern in which the light races, as compared with the dark, are more abundant in the first part of the nonbreeding season and gradually become less abundant with the passage of the second part and the approach of the breeding season. Because the advent of the breeding season is relatively late for the more nearly boreal populations of *oblitus* and *labradorius*, it is not surprising that these races seem well represented among those individuals lingering until May on the southern wintering ground.

SUMMARY

In the Savannah River Plant area, Aiken and Barnwell counties, South Carolina, the Savannah Sparrow (*Passerculus sandwichensis*) was the most abundant bird inhab-

iting old fields that had been abandoned for three or more years. In January-February, 1956, some 447 individuals were caught, banded, and released (mostly in a single, large field); other birds, collected or banded at other times, brought the total sample to 559.

Aided by a series of sparrows identified as to subspecies or geographic race, we endeavored to assign race designations to all individuals that were handled. Birds considered racially atypical or non-characteristic were designated as intermediates but were always placed nearer one race or another. We found, as had Johnston (1956), who had assembled a series of specimens from the same area in the previous winter, that the population of Savannah Sparrows included birds referable to five races. Our figures on the relative abundance of these races were as follows: *P. s. mediogriseus*, 30.1 per cent; *savanna*, 27.9; *labradorius*, 18.4; *oblitus*, 17.5; and *nevadensis*, 6.1. Thus *labradorius* and *oblitus*, both dark-races with more northern breeding grounds, comprised about 36 per cent of the entire sample. Many of the birds wintering in the Savannah River Plant area had necessarily migrated eastward as well as southward; this "migratory drift" is best illustrated by the western race *nevadensis*, relatively uncommon in our sample. More than half the total birds examined were considered racial intergrades or non-characteristic individuals. Weights of specimens, averaging about 17 grams in fall and winter, increased to about 19 grams in spring. Specimens of the smallest-sized race *mediogriseus* weighed about 92 per cent as much as those of the heaviest race *oblitus*. In *labradorius* the wing was large relative to body weight, in *mediogriseus* it was small, and in other races intermediacy was shown in this proportion.

In 1955-56, the first autumnal migrant was noted on September 27. Common by early November, the species was abundant throughout the winter. Its numbers declined abruptly in early April, and the last bird was seen on May 16. For the nonbreeding season as a whole, in an abstract community involving about 70 different fields, there was an average of approximately 3.9 Savannah Sparrows per acre (as determined by two census methods). The dark races *labradorius* and *oblitus*, while represented among the earliest arrivals in fall, became relatively more prevalent in early spring, and were the only races recorded as late as May. There was no evidence of differential habitat selection or other segregation among the different races. This seemingly complete spatial overlap of the racially different populations, which had "funneled down" from far-flung breeding areas in the northern United States and Canadian regions, is presumed to be selectively advantageous to the species on its wintering ground.

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Aiken, South Carolina, and Rome, Georgia, September 1, 1956.

SOME REMARKS ON THE BEHAVIOR OF THE YUCATAN CACTUS WREN

By DALE A. ZIMMERMAN

In its very restricted range in the coastal scrub of the northern part of the Yucatán Peninsula, the Yucatán Cactus Wren (*Campylorhynchus yucatanicus*) is a common bird. A number of ornithologists have seen it, but little is known about its habits. Paynter's (1955:218) only reference to its nesting is a citation of the report of Stone (1890) who found a nearly completed nest on March 19. Apparently nothing has been published on its voice or displays.

Newly built nests of this cactus wren were numerous southwest of Sisal, Yucatán, where we were established in camp from May 7 to 9, 1956. Within a short distance of the camp I located six pairs of wrens, each attending a nest. The species was almost invariably seen in pairs, suggesting that incubation had not yet begun, and at least two nests were still under construction at that time. Low *Opuntia* cacti were common in the vicinity, but I saw no nests in them. Instead, nests were situated from four to seven feet above ground in dense, broad-leaved shrubs (figs. 1 and 2). They were roughly spherical structures of coarse grasses and small twigs, about ten inches in diameter and with an entrance hole below the center on one side. The single one I examined closely was lined only with grasses, but it may not have been completed. A considerable proportion of the nesting material gathered by one pair (both sexes?) came from the numerous old cactus wren nests in the vicinity.

Because of its voice, this wren was one of the most conspicuous birds in the scrub belt. Although most of its calls were *Campylorhynchus*-like in quality, all sounded very different from those of *Campylorhynchus brunneicapillus*. Duet vocal performances were common. These were given only when two birds (apparently a mated pair in each instance) were perched side by side or very near one another in a shrub or on a dead sisal stalk. The birds stretched their necks upward, spread and vibrated or waved their wings, fanned their tails, inflated their throats, and bowed or bobbed up and down elaborately while calling their gruff, throaty, and rather slowly uttered "growling" notes: *chuff chuff chuff chuff chow chow chow chow*. Frequently during a performance, one bird ceased singing for a few seconds while the other one carried on. Rarely, one hung upside down with wings and tail spread and vibrating as it sang in unison with its mate which was posturing similarly (but in an upright position) below (fig. 3G). Sometimes this action terminated the display, but usually one or both birds abruptly flew from the perch following a brief period of intensive singing during which both individuals, standing high, waved their heads from side to side (figs. 3D and F).

Performances took place in various shrubs but not in the 20-foot mangrove trees that formed a solid border to the strip of scrub inhabited by the wrens; two nests were within 65 and 75 feet of the mangrove swamp. The action frequently began near the base of a tall, dead sisal stalk. One bird always preceded the other in the flight to the plant. Upon arrival of the second bird, the "growling" and posturing commenced, simultaneously by each individual, and the wrens slowly hopped and fluttered up the bare stem to the terminal branches where the actions described previously continued for several seconds or minutes. Throughout the performance the birds remained within a foot or so of each other, pausing quietly at brief intervals as they worked upward and after they reached the branches.

The display often took place between a bird's flights to its nest with material. On May 8, the first such trip I observed occurred at 8:45 a.m. After the wren's grasses were added to the nest, it flew to a small branch near the top of a sisal stalk 20 feet from the nest shrub. As it arrived, its mate alighted beside it. Both birds immediately raised

their heads and uttered a low-pitched, guttural, but very loud and emphatic *chee! chee! chee! chow! chow! chow! chow! chow! chow! chow! chow!* This lasted nearly four seconds and was followed by a softer chatter accompanied by wing-spreading, wing-waving, and rapid bowing. Another loud duet song was uttered. Then one bird preened its feathers as the other dropped down into the brush. There it spent some minutes gathering more grass which it took to the nest. It was followed by its mate but I could not see where the second bird went. Suddenly both flew back to the base of the same sisal stalk and



Fig. 1. Habitat of Yucatán Cactus Wren three miles southwest of Sisal, Yucatán, May 9, 1956. This vegetation type is confined to extremely narrow strip along immediate coast; in the 30 miles between Sisal and Celestún it is only a few hundred yards in width.

worked their way an estimated eight feet upward, "growling" and posturing. Once they reached the branches they continued the noisy display for three minutes, interrupted only when a large, low-flying flock of Eastern Kingbirds (*Tyrannus tyrannus*) flew directly overhead. The wrens stopped, looked up at the kingbirds and watched after them for several seconds, then suddenly resumed their duet as if nothing had interfered. The two display periods and two trips to the nest occupied approximately 15 minutes.

The photographs presented in figure 3 illustrate part of a "climb" up a sisal stalk and the subsequent display. When the display was underway, parts of the birds' bodies were almost constantly in rapid motion, and numerous photographs taken at speeds of $1/250$ and $1/500$ of a second were badly blurred.

The wrens had numerous chattering notes similar in quality to those previously described which I did not record. One pair uttered a somewhat more elaborate, rolling *cheerow cherrow chowk chowk chowk cherrow*. Still another song sounded like *chúck chawéék chawów, chúck chawéék chawów*. This was given by a lone bird from a secluded perch not far above the ground. Vocal efforts that I interpreted as territorial songs,

given by single birds from conspicuous perches, were not common. However, one such evening song, quite different in quality from the "growling," was heard from a bird on May 7 and 8. I recorded the phrase, which was repeated several times before a pause, as *what-a-luk, quaaaaark*, the last note drawn out and abruptly descending in pitch. This individual's morning song, heard first at 5:10 a.m., before sunrise, was a somewhat chat-like *chook chook tawir eek*, repeated three times from the top of a five-foot sisal stalk. I heard this only a few times, and only rarely after 6:00 a.m.



Fig. 2. Adult Yucatán Cactus Wren near its nest (lower right corner) in top of five-foot shrub, three miles southwest of Sisal, Yucatán, May 9, 1956.

Upon examining the literature for purposes of comparing the habits of *yucatanicus* with those of other cactus wrens, I find there is surprisingly little published information on the displays and vocal behavior of *C. brunneicapillus*. Woods (in Bent, 1948:229) writes of a "rapid repetition of a single staccato note. The quality of this note varies, but never in the same series. This type of call is usually delivered from the top of a tree, a building, or a pole, sometimes antiphonally by a pair of birds on the tops of different bushes." Anthony (also in Bent, *op. cit.*: 232) writes that the "normal note" of *Campylorhynchus brunneicapillus bryanti* is "quite harsh and unmusical, consisting of a series of notes rapidly uttered in a monotone." Dawson (1923:664) refers to the song of *C. b. coeusi* as "a rich yodelling alto of uniform tone—uniform, that is, save for the light crescendo with which the series opens, and the fading murmur of its closing note." Brandt (1951:184) wrote of an Arizona Cactus Wren that "uttered incessantly his 'riv-riv-riv-riv' notes, always in the selfsame key and so rapidly that one could not count them audibly. The series ran from 8 to 12 notes with a considerable pause between each group." He mentioned another song with 12 to 18 notes per group, and wrote further: "In addition, this wren has a series of coarse, scolding notes similar to those of the House and the Long-billed Marsh wrens, which is entirely unlike the territory song. These anger notes, however, are seldom used except in cases of unwelcome intrusion upon its territory."

Most authors describe the voice of *C. b. couesi* as a monotonous, rapidly uttered "choo-choo-choo-choo," "chut-chut-chut," or "chair chair chair" (Hoffmann, 1927); "cheh-cheh-cheh-cheh," "chug-chug-chug-chug . . ." (Peterson, 1941). Mrs. Bailey (1928:542) quotes Merrill's description of a more complex phrase: "chur-cha-ra, chur-

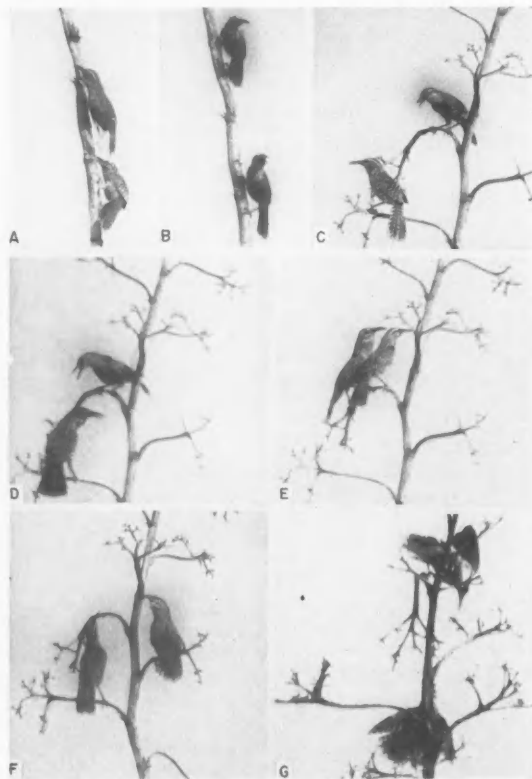


Fig. 3. A pair of Yucatán Cactus Wrens singing and displaying on a sisal stalk about 20 feet from nest shown in figure 2. Photos of this series were taken in sequence as the birds progressed from near base to top of plant. The initial part of the "climb" and various positions assumed by the birds in the branches are not represented. Photo G is of same individuals but in another series.

cha-ra, chur-cha-ra, chur-cha-ra.''' My own limited experience with *couesi* in Texas has not revealed any song not adequately represented by these descriptions. I do not recall them changing notes within one phrase, although possibly they do. Most phrases I heard from *yucatanicus* contained two or more distinctly different notes. When a phrase consisted of the repetition of one note, that note was invariably di-syllabic (*chúrry chúrry chúrry*; *chewówl chewówl chewówl*). Furthermore, these calls were seldom given by

one bird. They did not seem to be the equivalent of the *churr-churr-churr* of *brunneicapillus* which is apparently the territorial song.

C. b. guttatus, which I heard in June near Guadalajara, Jalisco, was not particularly vociferous except for scolding notes given when I approached nests, which contained young at the time. However, I heard several *churr-churr-churr* songs that sounded similar to those of Texas birds. Interestingly, Beebe (1905:95), writing of birds near Guadalajara, said "A harsh *churr! churr!* is their only utterance, apparently an alarm note, for as we passed along, the mesquite fairly hummed with the sound, surrounding and accompanying us."

The only reference I have found to displays of *C. brunneicapillus* is that of Mrs. Bailey (1922:164) who wrote: "On January 15, a warm day that might have suggested nesting time, I heard an outburst of song and found four Cactus Wrens excitedly gathered about one tree which contained two old, broken-down nests. Two of the birds were singing with great animation, one on top of a bush spreading his tail. On January 29, another spring-like day, Mr. Bailey found some of the wrens . . . 'singing, chasing, and fighting.' Then, on February 15, what appeared a bit of courtship rivalry was witnessed."

I have found no mention of duet singing or of elaborate displays which, if they occurred with any regularity in *C. b. couesi*, would almost surely have been described. I have spoken with several persons who are familiar with *C. brunneicapillus* in Texas and Arizona, and none, apparently, has witnessed such behavior.

Duet singing is common among Central American "cactus wrens." Excluding *brunneicapillus*, I have heard what I believed to be duet singing from all Mexican species except *chiapensis* and *megalopectus* which I have seen but once or twice in the field. Skutch (1940:296) refers specifically to *C. zonatus*, *C. rufinucha capistratus*, and *C. chiapensis* as species which "perform in unison rather than in the antiphonal fashion."

Van Rossem (Dickey and van Rossem, 1938:432) wrote as follows of *C. rufinucha capistratus* in El Salvador: "The reunion of a pair of birds which has been separated for a few minutes is always cause for an outpouring of several seconds' duration, as both birds go through their unmusical repertory with outspread tails and quivering wings." These remarks apply equally well to the Yucatán Cactus Wren. It is perhaps significant that van Rossem did not compare the actions of *C. r. capistratus* with those of *C. brunneicapillus*, a bird he knew quite well.

Blake (1953) and Paynter (1955) have followed Hellmayr (1934) in treating the isolated *yucatanicus* as a race of *C. brunneicapillus*. However, the differences in song and displays between these two forms, in conjunction with the well-known morphological differences, are strong evidence against considering them conspecific.

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University of Michigan Museum of Zoology, Ann Arbor, Michigan, September 14, 1956.

BIRD REMAINS FROM AN OREGON INDIAN MIDDEN

By LOYE MILLER

By invitation of authorities at the University of Oregon, I undertook a general survey of bird remains that were retrieved by workers in anthropology at an Indian campsite on the Columbia River at Five Mile Rapids, five miles east of The Dalles, Oregon. Dr. J. Arnold Shotwell of the University of Oregon first suggested that there might be condor bones in the collection. Dr. L. S. Cressman, under whose guidance the work was carried on, sent me two shipments aggregating approximately nine thousand bird bones or fragments and asked that they be classified as to genus. Results of this study are here presented.

Acknowledgments.—Dr. Cressman has been most cooperative in furnishing material and data such as are at present available. Dr. Shotwell has informed me that the mammal fauna thus far identified includes no extinct species. The excavation was carried out by the Department of Anthropology of the University of Oregon under permit from the National Parks Service and was supported in part by a grant from the National Science Foundation. My indebtedness to these several parties is gratefully acknowledged.

LOCATION, AGE, AND MATERIAL

The Five Mile Rapids Site (WS-4) represents an early Indian village that was seemingly occupied continuously for a great many years and was later covered over by a hard-pan stratum several feet in thickness. Above this hard-pan subsequent fill and changes in culture are indicated. The bird remains are all from the lower deposit and the second shipment all from the part later designated as the condor layer. Dr. Cressman and his advisers consider the age to be at least 9000 years. Carbon-14 tests have lately been completed that indicate slightly less than 8000 years. The site is situated in what is today designated as the Great Basin faunal area.

The specimens came to me in packages representing sections and levels as they were retrieved in the "dig." A package might contain one fragment or it might contain fifty. The material from each package was spread out upon a tray, classified, recorded and returned to its container. There were 51 packages in the first shipment of 3000 bones and 69 packages in the second of 6000 bones.

Except for fracture, the bones are well preserved, colored warm brown and somewhat mineralized. Heated in the Bunsen burner flame they gave off some white smoke but very little odor. Surface markings were as sharply defined as in a freshly prepared specimen, although seldom was an unbroken bone encountered.

DISCUSSION

Approximately nine thousand bones were identified as to genus or species and there developed some interesting "pictures of the past." Surprisingly few species were represented with any degree of frequency. Gull (*Larus* sp.) bones were in every sizable package and usually in quantity. Cormorants (*Phalacrocorax*) occurred in 89 packages, and 105 contained Bald Eagle (*Haliaeetus leucocephalus*). The next species in abundance, to my surprise was the California Condor (*Gymnogyps californianus*) which appeared in 53 packages. Only two bones were recognized as duck and seven as goose. Twelve packages yielded the Raven (*Corvus corax*), twelve the Turkey Vulture (*Cathartes aura*) and five a magpie (*Pica*). One bone was that of a coot (*Fulica americana*) and one a buteonid hawk, and most surprising of all, there was a single bone of the extinct vulture *Coragyps occidentalis*.

Less than a dozen bones in all showed signs of immaturity; these represented raven, crow, hawk, falcon, and goose. There must have been little or no nesting ground near the site during the season of occupation by the Indians. In the Gulf of California on a spring cruise, I found the natives crossing some ten miles of gulf waters by canoe to gather eggs and young of boobies, pelicans, and even Ospreys for food. Howard (1929) found the young of cormorants very abundant in the Indian midden at Emeryville on San Francisco Bay, California. Had young birds been more available at the Oregon site, their bones would surely have been present in the collection. Those that were found were well preserved. Were the Indians too nearly satisfied with the spring run of salmon to travel far afield or had they limited means of travel?

The total lack of wading birds (Charadrii, Gruidae, Ciconiiformes) and of the divers (Gaviidae, Colymbidae) would strongly suggest the absence of lagoon or marshy country in the near vicinity. Small molluscs that were found in the midden are considered to be indicators of "semi-permanent lagoon-like bodies of water" (Cressman, personal note) but such bodies must have been too small in size or too ephemeral in nature to attract appreciable quantities of wading birds. Cormorants and gulls are not necessarily indicative of lagoon waters. Cormorants often fish in fairly active water, coming ashore on beaches to sun or to roost.

Gulls would be attracted in considerable numbers by cast up carcasses of post-breed-ing salmon or by human refuse. A sizable mob of gulls assembled about a large salmon carcass would offer a fairly easy target for the human hunter using throwing stick, sling stone or bow according to his stage of development in armament. The great mass of gull bones strongly suggests the use of nets that would increase the percentage of catch from such a mob.

Like the gulls, the Bald Eagle is well known as a scavenger with a special predilection for fish. The species perhaps occurred in considerable numbers along the margins of the Columbia River as it occurs today along certain beaches in Alaska. Large size of the measurable eagle bones from the kitchen midden indicates Alaskan affinity systematically. Striking aspects of the whole avifauna are the great abundance of a few species and the high degree of fragmentation of their bones. As in the case of the condor material, not only are the long bones broken but the short, stout bones such as the coracoid and tarsus have been broken in such manner as to suggest considerable force purposefully applied.

Eagles and condors were of great significance in the rituals of some California Indians. Condor nests were even hereditary property among the Diegueño Indians. Young were taken from the nest, reared in captivity and sacrificed at annual rituals (Kroeber, 1925:676). Actual slaying of the sacrificial bird among certain Arizona tribes today is accomplished by wringing the neck in order to avoid shedding any of its blood. Later the heart might be taken out and eaten to impart strength and courage. The foothills Indians of California used the Golden Eagle in mourning ceremonies. The slain bird was passed back and forth from one clan to another with much dancing and expressions of grief, but I have been unable to learn whether or not mutilation resulted.

It has occurred to me that fragmentation of many of the bird bones might have been the work of Indian dogs or of other carnivores that had become camp hangers-on. Canid jaws and teeth have been identified among the mammal remains. On the other hand the fragile bones of the Magpie, Sparrow Hawk, and Screech Owl have been recovered in perfect condition. The slender limbs perhaps offered too little flesh to attract either man or beast.

Only two bone fragments in the entire collection show any suggestion of contact with fire and this suggestion is most uncertain. Nor is there any trace of gnawing by

rodents such as occurs in many cavern deposits or on bones that have lain exposed for any length of time.

REMARKS ON CERTAIN SPECIES

Gymnogyps californianus. California Condor. Indian middens from western Oregon have yielded condor remains (A. H. Miller, 1942) in limited quantities but eastern Oregon belongs in the Great Basin faunal area where condors are unknown in historical time. Subfossil remains in Nevada, New Mexico, and Texas have represented the genus but sparingly. In these cases also there is an uncertain association with several extinct species as well as with Basketmaker types of human artifacts.

The remains here discussed are surprisingly abundant, some bones were complete, others easily restored and all were unweathered. The exact specific identity is open to some question. *Gymnogyps amplus* was described from the California Pleistocene on the basis of its broad tarsometatarsus (L. Miller, 1911:390). A generation later all the Pleistocene remains of *Gymnogyps* were assigned to the species *amplus* by Fisher (1944) who considers it probably the ancestor of our Recent bird. He bases his opinion on characters of the skull—an element regrettably imperfectly represented in Indian middens thus far. Limb and body elements of the two species were not recognizably different according to Fisher. I am not in complete agreement with him as to his major conclusion.

The type specimen of *G. amplus* is a tarsometatarsus that is "very broad as compared with *Gymnogyps californianus* (Shaw); foot set inward on the shaft so that the median line of the shaft falls outside the center of the foot" (Miller, 1911:390). In 1941 I re-examined this specimen in comparison with the great series of Pleistocene condor bones in the Los Angeles Museum but no specimen was found that duplicated the great width of tarsus seen in the Shasta bird. The only tarsi recovered from the midden are very definitely of the *californianus* type, so I am recording them as such, although it is freely admitted that there may have been a slightly different facies of condor inhabiting the Great Basin area during late Pleistocene or very early Recent time. Some of the Indian midden bones are larger than any in our limited series of Recent material but others are smaller. The Pleistocene material has a marked tendency toward larger size.

Subfossil condor remains have been discovered in the main by archeologists. The suggestion is that condors have been of interest to the American Indian from Basketmaker time down to the present and all the way from western Texas to Oregon (Howard and Miller, 1933; Wetmore and Friedmann, 1933).

Coragyps occidentalis. Two fragments (nos. 1640 and 1545) were sorted out of the general mass and designated as cathartid. Placed later in juxtaposition they were found to fit perfectly together making up an almost complete right humerus. The distal articulations beyond the brachial depression are wanting but the strongly curved shaft which readily distinguishes *Coragyps* from *Cathartes* is immediately recognizable. The bone is stouter than some of those of *Coragyps occidentalis* from Rancho La Brea but it is a perfect match for others in the series.

This species, widely distributed in Pleistocene time, has been found in cave deposits, sometimes almost certainly associated with Basketmaker artifacts at deeper levels but giving place at upper levels to *Cathartes aura* or *Coragyps atratus*. It is of great interest to find it here even though so sparingly represented. The state of preservation is the same as that of the other bird bones. The species seems to have dropped out along with the Pleistocene camel, horse and ground sloth at about the time of man's first appearance in the southwest.

Cormorants. It is not out of order to find cormorants all through the interior of our

western states wherever there is water even in small bodies. I have taken the Double-crested Cormorant (*P. auritus*) in the Mojave Desert at a reservoir less than 100 feet long. This is the only species of cormorant found today on our inland waters and probably is the one represented in this collection. Our small series of skeletons at hand shows much size variation even in birds of the same sex. A few rather large bones occur among the great mass of cormorant remains from the midden but I hesitate to ascribe them to the large Alaskan subspecies.

Table 1

Frequency of Occurrence of Avian Types in Packages

Species	Packages in shipment I	Packages in shipment II	Total
Cormorant	46	43	89
Goose	4	3	7
Duck	2	1	3
Condor	14	39	53
<i>Coragyps</i>	1	....	1
Turkey Vulture	5	7	12
Bald Eagle	45	60	105
Prairie Falcon	1	....	1
Sparrow Hawk	3	3	6
Buteonid Hawk	....	1	1
Coot	1	....	1
Gull	49	57	106
Screech Owl	2	....	1
Raven	7	5	12
Crow	....	7	7
Magpie	2	....	2

Gulls. Great numbers of coracoids, and humeri, some tarsi, a few beaks and metacarpal dominate the gull picture. For some reason not evident, femora and tibiae seem less abundant. All these elements vary considerably in size and of course there is no association within the matrix. More than a dozen species of gulls occur along the coast in winter, two of the smaller of which breed on fresh waters of the interior. Gabrielson and Jewett (1940) report that the large Glaucous-winged and Western gulls may wander up the Columbia into the basin region. There is thus a chance of at least four species being represented in the scrambled mass of gull bones. Specific designation was therefore considered unwise.

Owls. It is surprising to find only two owl bones in the entire collection. A humerus is not distinguishable from that of the Screech Owl (*Otus asio*). These small owls of one race or another are distributed over the entire state where cover is available. I heard the characteristic notes in June of 1899 while camped at the junction of Cottonwood Creek and the John Day River. The presence of the bones thus suggests that there may have been some timber along the Columbia River at the midden site, since these birds are generally restricted to fairly dense cover or to cliff crannies.

The larger owls appear commonly in legends and ceremonials of western Indians. Howard (1929) found fairly abundant remains representing three genera in the Emeryville midden. Petroglyphs on the stones near The Dalles depict Horned Owls in several different poses, including flight. Were these artists of a later culture than the people who accumulated the midden?

Magpie. The California Indians used magpie feathers commonly in ceremonial re-

galia. Why are magpie bones (*Pica*) so rare in this midden? Three bones were found in one packet and two in another and, notably, they are less broken than those of larger birds. The slender tibiotarsus and coracoid are intact.

SUMMARY

An Indian mound of early age near The Dalles, Oregon, yielded 9000 bird bones assignable to sixteen species only four of which occur in numbers. One of these four is *Haliaeetus leucocephalus* and one is *Gymnogyps californianus*.

A single bone represents the extinct species *Coragyps occidentalis*.

Gymnogyps is here first recorded from the Great Basin faunal area in the historical period. It is a type of bird that appears to have interested primitive man from very early times.

One striking feature is the total absence of waders, divers, and gallinaceous species.

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Museum of Vertebrate Zoology, University of California, Berkeley, California, May 15, 1956.

BIRD NOTES FROM WESTERN KWANGSI, CHINA

By STEPHEN W. EATON

The avifauna of western Kwangsi Province in China has never been adequately studied. Yen (Oiseau, 3, 1933:204-243, 615-638, 755-788; 4, 1934:24-51) and Yen and Chong (Oiseau, 7, 1937:546-553) have published fairly recent lists for this province but they state that they have not explored the area at the frontier of Yunnan which lies to the west. This paper concerns the birds of that little known region and serves to supplement previous lists. Three birds (*Elanus coeruleus*, *Upupa epops longirostris*, *Acridotheres grandis*) not previously reported from the province and notes of interest on others seen and collected are reported here.

From November 30, 1944, to July 20, 1945, I was stationed with a fighter control detachment of the Fourteenth Air Force near a town called Poseh on the West River. I was absent from the area only in the month of January and in a few days in July.

Poseh is approximately 25 miles north of the tropic of cancer, 500 miles west-northwest of Hong Kong, about 200 miles inland from the Gulf of Tonkin of the South China Sea, and about 75 miles north of the Indo-China border. The town is located at the head of navigation on the West River at about 600 feet above sea level. Mountains, which rise to 3000 feet, surround the town and valley. Downstream the valley fans out to become about five miles wide, but upstream from Poseh the river cuts precipitous cliffs through the mountainous country which is contiguous with that of Yunnan to the west and Kweichow to the north.

Like much of China the countryside has been nearly stripped of trees, but along the river are a few places which one might call forested. Bamboo, banana trees, an occasional banyan tree, and trees of the genus *Bombax* are constituents of this wooded area. Almost every available foot of the valley proper is honeycombed by rice paddies, which often extend up into the foothills of the mountains. The hills surrounding the valley are covered with grasses and in a few areas scattered pines (*Pinus sinensis*) remain. One finds occasional oases of trees along the tributaries of the river. Usually near houses at least two or three large trees have been spared to furnish shade during the hot season.

Seasonal fluctuation in temperature and amount of rainfall in the Poseh region is much more marked than it is along the Gulf of Tonkin where the tempering effect of the ocean is felt. From November to February the weather at Poseh was cool—50–60 degrees F.—during the day. At this season the rice paddies were dry. By the first of March, *Cercis chinensis* was in blossom and near the end of the month *Bombax* blossomed. At the beginning of May, the rainy season started and the farmers began planting rice. By the middle of June, the weather became very hot and humid.

Birds which wintered near Poseh departed for the north in March and the first part of April; those wintering south of the area passed through on their way north about the end of April and the first week in May. Nesting begins, for many species, about April 1 and continues to about the middle of June when the excessively hot season commences.

The avifauna of the Poseh region, as might be expected, has decided affinities with that of Tonkin, Indo-China, to the south (Delacour and Jabouille, Oiseau, 10, 1940:89–220) and of southeast Yunnan Province to the west (La Touche, A Handbook of the Birds of Eastern China, 1925–1934, 2 vols.). This may be illustrated by the presence of the following birds at Poseh: *Falco tinnunculus saturatus*, *Upupa epops longirostris*, *Artamus fuscus*, *Acridotheres grandis*, and *Dicrurus leucophaeus hapwoodi*. Other birds noted in the course of the breeding season are typical of the avifauna of southeastern China (La Touche, *op. cit.*). Examples of birds wintering at Poseh but which nest to the north of the region are *Circus melanoleucus*, *Saxicola torquata* and *Melophus lathami*.

An annotated list of birds seen and collected during my stay in the Poseh area is presented below. Those species preceded by an asterisk were collected and are now in the Cornell University Collection. Many thanks are due George Popovich, a member of our detachment, who collected many of the specimens, and to Dean Amadon and Kenneth C. Parkes for aid in their identification.

Ardeola bacchus. Chinese Pond Heron. On May 7 I saw one individual in the hills back of camp along a little tributary of the West River. This was the only individual seen near Poseh, but from the air it appeared common along the river 100 miles southeast.

Milvus lineatus. Black-eared Kite. From November 30 to December 24 kites were fairly common at Poseh but were not seen from February to July; they probably were winter visitants here.

Elanus coeruleus. Black-winged Kite. On March 27 and again on April 2 I saw one south of the fighter strip. It was perched on a telephone pole and was making short excursions out over the valley. Once the bird was seen to hover like a Kestrel for a few seconds. This bird has not previously been reported from Kwangsi.

Circus melanoleucus. Pied Harrier. One individual spent the cool months cruising back and forth over the fighter strip in search of food. The bird was first seen on November 30 and was last seen on April 11. Between these two dates I saw it almost daily. Yen (Oiseau, 3, 1933:237) collected one specimen at Yoaschan on May 7, 1931.

Circus aeruginosus. Marsh Harrier. In February a single individual hunted over the valley near the fighter strip. This species is probably a migrant here.

**Falco tinnunculus saturatus*. Kestrel. From November 30 to December 24 Kestrels hunted over the valley daily; later they were noticed less frequently. One female of this subspecies, collected on July 22 south of Poseh, had large grasshoppers in its stomach. The only record Yen (Oiseau, 3, 1933:230) cites is a pair of this species seen by Vaughn and Jones in the West River Valley.

Phasianus colchicus torquatus. Ring-necked Pheasant. I never saw this bird in the valley or in the hills surrounding Poseh, but 75 miles northwest near Anlung, Kweichow, I saw two males and a female along a five-mile stretch of road. This was in barren hilly country.

**Francolinus pintadeanus pintadeanus*. Chinese Francolin. This was a very common resident bird at Poseh. In November and December it was occasionally seen near the bases of the surrounding hills but later it seemed restricted to the hillsides. In April and May I frequently heard their calls which, to my ear, resembled the call of the California Quail (*Lophortyx californicus*). Popovich bought a live bird from a native on February 23 which was made up as a skin. This bird was a male with testes about 2×6 mm., iris brown, tarsus orange, bill grayish.

Tringa hypoleucos. Common Sandpiper. From November 30 to December 24 I saw a few individuals along the bank of the West River. Probably these were migrant birds.

Streptopelia orientalis. Rufous Turtle Dove. One individual inhabited the grove of trees surrounding a farmhouse near Poseh from November 30 to December 24.

Streptopelia chinensis. Chinese Spotted Dove. This species was a fairly common permanent resident and a favorite food at Chinese banquets.

**Centropus bengalensis lignator*. Lesser Crow-pheasant. On April 2 I saw one cross the road just south of Poseh. On May 25 Popovich collected a specimen near the fighter strip. It was a female with an egg in the oviduct and insects in its stomach.

Hirundo apus caudacutus. Spine-tailed Swift. On May 6 a flock of more than 50 swifts milled over camp for half an hour. They were probably of the migratory subspecies *caudacutus*.

Ceryle rudis. Chinese Pied Kingfisher. Along the river from November 30 to December 24 this kingfisher was fairly common.

**Halcyon smyrnensis fusca*. White-breasted Kingfisher. I saw one in the hills and one along the river between November 30 and December 24. On March 7 a dead bird was seen tied to a pole in the middle of a vegetable garden. In April and May the birds were noisy and their raucous calls were a common sound. A male collected on May 5 had testes measuring 3×6 mm.

**Upupa epops longirostris*. Hoopoe. A female was collected by Popovich on February 21. On March 7 another individual was seen back of headquarters. This subspecies occurs on Hainan and in Tonkin but has not previously been reported from Kwangsi.

Alauda gulgula. Lesser Skylark. This lark was a fairly common resident of the valley. On March 1 the first flight songs were heard.

Hirundo rustica. Barn Swallow. Between November 30 and December 24 this swallow was seen occasionally. By February 16 it appeared to be more common than in December. The first eggs of this species were found on April 2 and on May 20 young were still in nests under the eaves of houses.

Hirundo daurica. Striated Swallow. I saw a few the last of March and a small flock on April 2 along the river.

**Dicrurus leucophaeus hopwoodi*. Ashy Drongo. On May 7 I shot a female in the top of a tall tree in hills behind headquarters. Its call was loud and pleasing; the iris was orange-red and the tarsus and the bill were black.

Oriolus chinensis. Black-naped Oriole. On April 25 I saw one along the river in a wooded area and again on May 7 in a small grove of trees in the hills behind headquarters.

Pica pica. Magpie. On April 25 I saw a pair of these birds near a nest along the river.

**Garrulux perspicillatus*. Black-faced Laughing Thrush. A young bird just out of the nest was collected on May 2. The iris was brown and the tarsus gray-brown.

Pycnonotus sinensis. Chinese Bulbul. In December a flock of about 12 birds fed on small fruits of trees in a grove surrounding a farmhouse near Poseh.

**Pycnonotus aurigaster resurrectus*. Yellow-vented Bulbul. One female was collected on March 4 with an ovary measuring 4×6 mm. The iris was dark brown and the tarsus brownish-black.

Saxicola torquata. Chinese Stonechat. From November 30 to the middle of April this bird was fairly common near Poseh. I did not see it after May 1; apparently it is a migrant here.

**Copsychus saularis saularis*. Chinese Dayal Bird. In December two or three birds frequented a grove near a farmhouse at Poseh. In April this thrush was in full song. On May 25 I saw a small Chinese boy carrying three young birds in a cage. They were spotted on the breast but had black and white remiges and rectrices as in adults. A male was collected on May 1 near Poseh.

Orthotomus sutorius. Tailor Bird. On April 25 I saw one of these in a woody area along the bank of the river. It was whistling its loud, melodious call note.

Cisticola juncidis. Chinese Fan-tailed Warbler. In December one individual was present in a grove of trees surrounding a farmhouse.

**Motacilla alba alboides*. Pied Wagtail. I shot a female on March 18 in mountains about 75 miles north of Poseh. Wagtails of this species complex were often seen along the banks of the river and around little pools of water near headquarters from November 30 to April 2.

**Artamus fuscus*. Ashy Wood Swallow. Throughout May a flock of about 30 birds "hawked" for insects between the river and headquarters. They traveled in a compact noisy flock reminiscent of young *Sturnus vulgaris*. An adult male was collected on May 3 from this same flock.

Lanius schach. Rufous-backed Shrike. One individual inhabited a little grove of trees near a farmhouse in the vicinity of Poseh from November 30 to December 24. In February and March this species frequented the area about headquarters.

**Sturnus nigricollis*. Black-necked Mynah. I saw two of these mynahs on April 25 near headquarters. On May 3 Popovich collected an adult female with a distinct brood patch.

**Acridotheres cristatellus cristatellus*. Crested Mynah. I first saw these birds on April 2 and from then on a few were seen daily feeding near water buffalos in the valley. A female with a well developed brood patch and large ovary was shot by Popovich on May 2. The iris was orange, the tarsus yellow, and the distal half of the bill yellow, while its proximal half was pinkish.

**Acridotheres grandis*. Long-crested Jungle Mynah. A male with large testes was collected on May 3 in the same area in which the above species was collected. This is a first record for the province. The presence of this species and *Acridotheres cristatellus* in the same area in breeding condition supports their treatment as species.

Zosterops simplex. South China White-eye. On May 7 I saw one individual in a forested area of the hills behind headquarters.

Passer montanus. Chinese Tree Sparrow. This bird was a common resident about village and country dwellings. In July it was one of the few birds to exhibit activity under the scorching mid-day sun.

Melophus lathamii. Crested Bunting. On April 2 two flocks of about 12 in each were seen 25 miles south of Poseh along the river. Another flock was near headquarters on March 10 and April 25.

Biology Department, St. Bonaventure University, St. Bonaventure, New York, September 6, 1956.

FROM FIELD AND STUDY

A Record of the Slaty Finch for Honduras.—When Miller and Moore (Condor, 56, 1954: 310–311) reported on a female Slaty Finch, *Spodiornis rusticus uniformis*, taken on Volcán Tacaná, Chiapas, México, they were unaware that there were two additional specimens of the species from Honduras in the Moore Collection. These specimens, both adult males, were taken on July 9 and 12, 1936, by C. F. Underwood at Montaña El Chorro and apparently constitute the first record of the species in Honduras. The specimen of July 12 has the label notation, testes “ $\frac{1}{2}$ enlarged.”

The validity of *S. r. barrilesensis* was questioned by Miller and Moore (*op. cit.*) and it was suggested that “further material may result in more definite suppression of *barrilesensis* in contradistinction to *uniformis*,” and this, in fact, seems to be the case. The bill of the type of *barrilesensis* was found to be abnormal and some of the characters must therefore be discredited. *Barrilesensis* does, however, share with *uniformis* a more massive bill than the populations of *S. r. rusticus* to the south. The width of the bill at the nostril of the Honduran specimens is 4.6 and 4.7 mm. and is therefore in agreement with previous findings. This, then, brings us to the supposed greater size of *uniformis* which according to Hellmayr (Cat. Birds. Amer., pt. 11, 1938:371) differentiates it from *barrilesensis*. The wings of the types of *uniformis* and *barrilesensis* as measured by Miller and Moore are 74.5 and 72.2 mm., respectively. However, as they show, this apparent disparity is somewhat reduced by Costa Rican examples, referred to *barrilesensis* by Hellmayr, which measure 72.2 and 73.8 mm. The wings of our specimens from Montaña El Chorro measure 73.6 and 71.2 mm., suggesting a slightly greater degree of individual variation than was previously realized. Although the sample is still too small for any significant statistical treatment, it would appear that there is no sound basis for considering *barrilesensis* as distinct from *uniformis* and it is to the latter that we refer our specimens.—ROBERT T. MOORE and DON R. MEDINA, Laboratory of Zoology, Occidental College, Los Angeles, California, May 9, 1956.

Nesting of the Ruffed Grouse in California.—The Ruffed Grouse (*Bonasa umbellus*) has long been known as a breeding bird in the extreme northern portion of California. However, most of the breeding records have been based on broods of young. Little information has been available as to nesting requirements and the nature of the nest. Through the courtesy of the late James Patterson of Willow Creek, Humboldt County, California, three nests of this bird were observed near that locality which is situated in the Trinity River area.

The first nest observed was found in late June of 1952, at which time the eggs had hatched and the young had left. The nest was situated on a rather steep slope at least fifty yards from the nearest riparian growth of a small side stream. It was sunk into the forest floor about six inches down hill from the butt end of a down log. The forest at this point was mixed growth of Douglas fir, madrone and oak, with little or no understory. The nest cavity was small for the size of the bird, which was reputed to have deposited ten eggs.

The second nest was found on May 7, 1955, and contained nine eggs, which had been incubated for about three days. The nest was deserted due to logging operations in the immediate vicinity. Again the nest was about fifty yards from the nearest riparian growth and was situated on a steep hillside. The usual mixed forest growth was present, with little or no underbrush. The nest cavity measured about five inches across and was at least four inches deep, the eggs being well below the surface of the forest floor. An oak tree was just above the nest cavity and formed an effective protective covering. A few dried leaves had fallen into the cavity, breaking up the outline of the clutch of eggs, which was difficult to see.

The third nest was found on May 14, 1955, and this contained eleven eggs. When the bird was flushed, the deep nest was not noticeable, and the few leaves falling into the deep cavity broke up the shape of the clutch of eggs. This nest was about six inches in diameter and about five inches deep. Again, the nest was located about fifty yards from the nearest running water and on a steep hillside. The usual mixed forest growth was present, but in this case there was considerable understory of the black huckleberry in the vicinity. The nest was outside the huckleberry area and again at the base of an oak.

All three nests were notable for their smallness and depth compared to those of other galliforms

that the writer has observed. All nests were on slopes adjacent to streams, where this species is chiefly found. The nesting period appears to be in the month of May. Clutch size ranged from nine to eleven eggs.—ROBERT R. TALMADGE, *Willow Creek, California, September 30, 1956.*

Avian-pinniped Feeding Associations.—While serving on an icebreaker in arctic waters, the writer observed several instances of marine birds feeding in association with pinnipeds. It appeared that the birds were attracted to the vicinity of pinnipeds where they fed either on scraps of fish or other marine animals that the aquatic mammals strewn about the ocean surface, or upon small fry frightened to the surface by the feeding antics of the pinnipeds. Probably some of the birds followed the pinnipeds to feed on their feces. In the southern hemisphere, the Elliot Storm-petrel (*Oceanites gracilis*) has been observed following whales (Murphy, *Oceanic Birds of South America*, 1936:759) and the Wilson Storm-petrel (*Oceanites oceanicus*) has been seen following feeding schools of fish such as carangids in search of scraps from their slaughter (*op. cit.*: 751). Flocks of Greater Shearwaters (*Puffinus gravis*) were also reported as following whales and porpoises to feed on their feces (*op. cit.*: 663).

The following are a few specific accounts noted in the Bering Sea and Arctic Ocean, arranged by mammalian species.

Odobenus divergens. Pacific Walrus. Ivory Gulls (*Pagophila alba*) and Glaucous Gulls (*Larus hyperboreus*) were seen feeding among walruses resting on the pack ice ten to twenty miles south of St. Lawrence Island in February, 1953. Apparently the gulls were feeding on walrus feces. On September 13, 1953, ten miles northwest of Atanik, Alaska, Glaucous Gulls were seen riding small, drifting ice floes with walruses, again apparently feeding on their feces. Nearby a flock of ten to fifteen Red Phalaropes (*Phalaropus fulicarius*) alighted on the water in the midst of a herd of swimming walruses and began feeding, relatively unconcerned with the bellowing, snorting, and splashing of the huge mammals, who were frightened by the approach of our ship. The phalaropes had miles of open water in which to feed but chose the association of the walruses, perhaps finding macroplankton more easily where the walruses had agitated the water.

Phoca hispida. Ringed Seal. In the Bering Sea during the winter of 1953, Kittiwakes (*Rissa tridactyla*) and Glaucous and Ivory gulls were seen feeding on seal carcasses but not in close association with living seals. On February 8, 1953, Fulmars (*Fulmarus glacialis*), in flocks of three or four individuals, were observed swimming in steaming open leads in the ice at about 179°W and 61°N in relatively close proximity to seals. Perhaps the two species were simply utilizing the same open water for feeding, neither profiting by the other's presence. In late August, 1953, ringed seals were found especially abundant in the loose pack ice in the northern end of Prince of Wales Strait between Banks and Victoria islands. Their presence was first detected by seeing small flocks of ten to fifteen Sabine Gulls (*Xema sabini*) and lesser numbers of Arctic Terns (*Sterna paradisaea*) hovering low over the water. The birds periodically dropped to the water, apparently picking up scraps of food that floated away from seals that surfaced. At one time, three such mixed flocks were seen flying after small parties of swimming seals. Throughout the latter part of August and the first week of September, 1953, practically every seal seen swimming was accompanied by an aerial escort of Sabine Gulls or Arctic Terns. Herring Gulls from the nesting colony on Princess Royal Island were also observed following seals, but they quickly deserted them in favor of the ship's garbage. Nesting Glaucous Gulls were more timid and were not seen among the seals, whereas flocks of Red Phalaropes up to fifty in number were observed resting on the ice and feeding in the water in close proximity to seals. Individual Pomarine and Parasitic jaegers (*Stercorarius pomarinus* and *S. parasiticus*) followed the gulls and terns, robbing them of their catches, but did not feed among the seals.

Eumetopias jubata. Steller Sea-Lion. Tremendously large flocks of shearwaters, mainly the Slender-billed Shearwater (*Puffinus tenuirostris*), were encountered in the Bering Sea from July 17 to 21, 1953. Many of these birds seemed so full that they could not fly but only splash and flap ahead of the ship. During this passage, sea-lions were also fairly numerous. Two individuals had dead fish which they tossed about and shook, much as a terrier shakes a rat. The fish were reddish colored and estimated to be about two feet long. Twenty to thirty shearwaters congregated about each sea-lion. At first glance, it appeared that a sea-lion had caught a shearwater and other shearwaters had gathered about their fallen companion. However, closer observation disclosed that the birds were feeding.

The birds swam and flew in close enough to the sea-lions to pick up fish scraps, some large enough to be seen with 7×50 binoculars at about 500 yards. The sea-lions did not molest the birds but seemed to ignore them. Long lines of low-flying shearwaters were also observed that diverged from their lines of flight to investigate swimming sea-lions, but in only the above-mentioned cases were shearwaters seen to alight and feed with sea-lions.

Callorhinus ursinus. Northern Fur Seal. On September 22, 1953, fifty-three miles northwest of Akun Island of the Aleutian Chain, a flock of almost 100 Fork-tailed Petrels (*Oceanodroma furcata*) and about 25 Fulmars was seen swimming about a pair of fur seals feeding among some drifting kelp. Several times the petrels fluttered off the water when the fur seals surfaced too close, but they landed again to continue feeding. Both bird species were apparently finding adequate food. The fur seals seemed curious and playful and did not attempt to catch any of the birds.

It is believed that the avian members of avian-pinniped feeding associations such as those described gain much from the association, whereas the mammals gain little if anything. However, the pinnipeds may at times locate food by swimming toward feeding flocks of birds, and some of the gulls may remove ectoparasites from walruses sleeping on the ice. Perhaps these associations are mainly a case of two animal forms feeding on a common source of food.—RONALD A. RYDER, *Utah Cooperative Wildlife Research Unit, Logan, Utah, August 22, 1956.*

Hummingbird Killed by Frog.—On September 13, 1956, my wife and I observed an unusual incident that resulted in the death of a female Rufous Hummingbird (*Selasphorus rufus*). The observation was made at 3:30 p.m. at a small lake impounded by Herb Martyr Dam in Cochise County, Arizona. The location is in upper Cave Creek Canyon about two miles west of the American Museum of Natural History's Southwestern Research Station in the Chiricahua Mountains.

As we sat on the north bank of the lake observing birds, the hummingbird, a migrant, perched momentarily on a partly submerged tree branch, then flew down and landed at the edge of the water about 30 feet in front of us. Apparently the bird sought a drink; it dipped its mandibles into the shallow water once after landing. Immediately a frog of unidentified species leaped from the grass near the water line, struck the bird a hard blow and knocked it into deeper water. The bird struggled in several inches of water as the frog followed up its initial attack by seizing the bird and diving with it into a bed of submerged vegetation. Neither bird nor frog reappeared on the surface. We searched for some 15 minutes without success in an effort to locate them.

Neither observer had ever before witnessed such a capture. Whether frogs regularly take hummingbirds under like circumstances or whether the bird was mistaken for a large insect is unknown.—MORGAN MONROE, *Phoenix, Arizona, September 28, 1956.*

A Bobolink in Southern California.—In the late afternoon of June 5, 1956, the writers were at Malibu Creek, Malibu, Los Angeles County, California, observing water birds. Almost immediately after arriving, we saw a small bird perched on a clump of grass and each of us, at almost the same instant, exclaimed that it was a male Bobolink (*Dolichonyx oryzivorus*). The bird was alone and remained on the same perch for at least ten minutes while we watched it. Although the Bobolink breeds in small numbers in the extreme northeastern part of California, this is, so far as we have been able to determine, the first record for the southern part of the state. In fact, from the available information, this appears to be the first record south of Monterey and Mono Lake, which would make it the most southerly record on the Pacific coast. While a sight record can never be as satisfactory as one that is substantiated by a specimen or acceptable photograph, the fact that both observers were thoroughly familiar with the species through long residence in the east, coupled with the fact that the male bird is unmistakable, leads us to report this unusual observation.—R. DUDLEY ROSS, *Pacific Palisades, California*, and RUTH P. EMERY, *Wollaston, Massachusetts, October 1, 1956.*

Yellow-billed Cuckoo Nesting in Yucatán.—In July of 1956, the Yellow-billed Cuckoo (*Coccyzus americanus*) was a familiar sight on a small ranch called Xocnache, 5½ miles by road southeast of Ticul, Yucatán. Consequently I was not surprised when I discovered an occupied nest of the species on July 15, the first definite breeding record for the Yucatán Peninsula. The bird carried food in its bill as it approached the nest, even though the nest held only eggs. Again the next day, after

the still incubating bird was frightened from the nest, it returned with food in its bill. On July 18, the day after a bad storm, the two eggs were found on the ground below the thorny bush which held the nest, and the nest was deserted.—ERNEST P. EDWARDS, *Amherst, Virginia, October 1, 1956.*

Miscellaneous Bird Records from Northeastern Nevada.—A number of noteworthy records have been obtained in northeastern Nevada in the past three years which supplement the recent lists by Linsdale (Condor, 53, 1951:228–249) and others.

Buteo lagopus. American Rough-leg. Johnson (Condor, 54, 1952:65) states that this hawk occurs "in Nevada as a widespread winter visitant," but cites only one record for northeastern Nevada. Actually this species is the common wintering *Buteo* in this part of the state. To cite individual records would require listing all parts of Elko, White Pine and Eureka counties visited from November to March. The earliest date of fall arrival recorded in this area is November 4, 1955, while the latest spring records were obtained on April 20, in 1954 and 1956. Throughout the winter months Rough-legs are common scavengers along the major highways, competing with Ravens (*Corvus corax*) and Black-billed Magpies (*Pica pica*) for the remains of road-killed rabbits and other animals. These hawks are somewhat more sluggish than their corvid rivals, and a substantial number is killed by fast-moving automobiles.

Sphyrapicus thyroideus. Williamson Sapsucker. On July 28, 1955, a small group was encountered in a stand of limber pines (*Pinus flexilis*) and subalpine firs (*Abies lasiocarpa*) at 9000 feet elevation on the southeast slope of Divide Peak, in the Jarbidge Mountains of northern Elko County. This is the second record for this species in northeastern Nevada; Evenden (Condor, 54, 1952:174) has reported it previously from about 15 miles south of Elko, Elko County.

Parus atricapillus. Black-capped Chickadee. A single bird was seen foraging in the willows and lower branches of cottonwoods along the south fork of the Humboldt River, 16 miles south of Elko, on April 11, 1954. This species has been recorded once previously in eastern Nevada, from the Shoshone Creek area, 106 miles northeast of this south fork area (Linsdale, Pac. Coast Avif. No. 23, 1936:87).

Troglodytes troglodytes. Winter Wren. On September 13, 1953, a single bird of this species was found living among the moss-covered stone ruins of the Hamilton water-pumping station, at 7600 feet elevation in Harris Canyon, 3 miles east of Hamilton, White Pine County. This seems to be the fourth record for this species in Nevada and the first for the eastern part of the state (Linsdale, Condor, 53, 1951:240).

Toxostoma rufum. Brown Thrasher. On March 10, 1956, a single bird was taken in a trap set at the Bill Hollan residence near Eureka, 6600 feet elevation, Eureka County. This bird was giving the Hollans much enjoyment and was not collected. It was banded with a Fish and Wildlife Service band and released. The Hollans said that this bird arrived in Eureka with the first winter storm in mid-November, 1955, and remained in the vicinity through the winter, feeding almost daily on commercial dried dog food. The thrasher survived the winter in good condition and still remained in this same locality as late as April 29, 1956. This is apparently the first record of the occurrence of this species in Nevada.

Bombcilla garrulus. Bohemian Waxwing. A flock numbering as high as 28 birds was present in and around Elko, 5200 feet elevation, from about January 3 to March 5, 1955. At least six of these waxwings were in the Elko area from March 5 to 7, 1956. While in the Elko area, these waxwings fed on the berries of ornamental shrubs around residences, especially on the fruit of snowberry (*Symphoricarpos*). Linsdale (*op. cit.*: 241) lists five earlier records from the state, but none from this area.

Hesperiphona vespertina. Evening Grosbeak. Linsdale (*op. cit.*: 244) cites one record for northeastern Nevada (from Gabrielson, Condor, 51, 1949:186). This species seems to be a common and regular fall and spring visitant in the Elko area. Dates of occurrence are: April 8 to May 14 and November 18 to 28, 1954; January 23 and April 9 to May 17 and October 13 to November 4, 1955; and January 1 to May 8, 1956.

Other scattered records for northern Nevada include: Elko County—8 to 10 birds in the juniper forest (*Juniperus osteosperma*) on the Elko Hills, about 8 miles south of Elko, April 10, 1954; a flock in The Granites area, east of Contact, October 20, 1955; about one dozen birds seen over Pole

Creek canyon, south of Elk Mountain, O'Neil Basin, November 5, 1955; three at Eureka, Eureka County, March 9, 1956; and at least one bird in Winnemucca, Humboldt County, March 27, 1956.

Leucosticte atrata. Black Rosy Finch. On February 12, 1954, a flock of 100 to 150 rosy finches was watched feeding on the shoulders of the highway east of Dutch John Mountain, about 36 miles north of Pioche, Lincoln County. These finches had apparently found a preferred food since they returned to feed at the same site immediately following the passage of each of five automobiles. The very dark bodies, gray head pattern, and the contrasting pink on wings and rump that characterizes the Black Rosy Finch (*L. atrata*) was readily discernible on many of the birds. Whether or not members of the other forms of *Leucosticte* were present could not be determined. This record supplements the recent Nevada breeding record for this species by Miller (Condor, 57, 1955:306-307).

Leucosticte tephrocotis. Gray-crowned Rosy Finch. A single individual of this species was observed in Overland Canyon, about 6500 feet elevation, on the west slope of the Diamond Mountains, 28 miles north-northeast of Eureka, Eureka County, on March 10, 1956. This bird was feeding among cheatgrass (*Bromus tectorum*) litter in a sheltered site. The distinctive gray cheek patches, black face and brown back of the race *L. t. littoralis* were noted. On March 16, 1956, Leonard W. Hoskins saw a flock of about 75 to 100 Rosy Finches foraging among the junipers in Carlin Canyon, 5400 feet elevation, 14 miles southwest of Elko, which he believed were also *L. t. littoralis*, on the basis of the conspicuous gray cheek patch.

Acanthis flammea. Common Redpoll. On November 16, 1955, one of a pair was taken at 7000 feet on Sun Creek, in the O'Neil Basin, 46 miles north of Wells, Elko County. This specimen proved to be a fat, adult female (now no. 133836 Mus. Vert. Zool.). Both birds were feeding on the seeds of a big sagebrush (*Artemisia tridentata*) close to willow-aspen association in the stream bottom. Ellis (Condor, 37, 1935:87) took a pair near Ruby Lake in northern White Pine County on November 2, 1929, some 114 miles south of the present record.

Spinus tristis. American Goldfinch. Linsdale (*op. cit.*: 244) records this species as a summer resident in Nevada, but cites late fall records by Gabrielson (*op. cit.*: 186) for east-central Nye County and southern Clark County. On November 18, 1955, a flock of about 20 to 30 goldfinches was observed at the mouth of Bishop Creek Canyon, 9 miles north of Wells, Elko County. These finches were part of a mixed flock of 200 to 300 birds foraging in a livestock winter feed-yard.

Loxia curvirostra. Red Crossbill. Linsdale (*op. cit.*: 244-245) cites one record from northeastern Nevada in 1868. A more recent record is one of a flock seen in the subalpine firs at 7500 feet elevation on the east side of Merritt Mountain, east of Mountain City, Elko County, on July 26, 1955.

Zonotrichia querula. Harris Sparrow. An adult female was collected at the Cottonwood Ranch, 6000 feet elevation, in the O'Neil Basin, 19 miles west of Contact, Elko County, on November 5, 1955 (now no. 133837 Mus. Vert. Zool.). This constitutes the first record for this species in northeastern Nevada and the third for the state.—GORDON W. GULLION, Nevada Fish and Game Commission, Austin, Nevada, May 13, 1956.

NOTES AND NEWS

John Davis has joined the staff of *The Condor* as Assistant Editor. Robert K. Selander begins a term of service in 1957 as a member of the Editorial Advisory Committee.

The Grayson painting which appears as the frontispiece of volume 59 of *The Condor* shows a group of three Gila Woodpeckers, two males and a female. The drawing was made by Grayson at Mazatlán, Sinaloa, México, in May of 1865.

The Cooper Society notes with regret the death of Howard Robertson on October 17, 1956. Mr. Robertson joined the Cooper Club in 1896 and was elected to Honorary Membership in 1949. He was largely instrumental in arranging the incorporation of the organization in 1934, bringing to bear his legal experience. From that year until 1948 he served as President of the Board of Directors of the corporation.

The following Committee on Arrangements was approved by the Board of Directors for the Annual Meeting of the Cooper Society to be held in Los Angeles, April 26-28, 1957: Thomas R. Howell (Chairman), Mrs. Vernon Barrett, Jean Delacour, Mrs. Paul D. Dodds, C. V. Duff, Ed. N. Harrison, Mrs. Thomas R. Howell, Hildegard Howard, Mrs. J. L. McBride, J. R. Pemberton, W. J. Sheffler, and J. C. von Bloeker, Jr.

Special features planned for the meeting include a visit to the aviary of Ray Thomas, a field trip to the condor country, a bird art exhibit at the Los Angeles Museum, and a showing of a Disney nature film.

Ludlow Griscom has resigned as President of the American Ornithologists' Union for reasons of health. He is succeeded as President by Ernst Mayr. Through action of the Council, George H. Lowery, Jr. has been advanced to First Vice-president and Austin L. Rand has been designated Second Vice-president.

The Conservation Department of Cornell University is conducting a research project concerned with hybridization in surface-feeding ducks, including the Mallard, Pintail, Black Duck, Gadwall, Green-winged Teal, Blue-winged Teal, and Shoveller. The purpose of this study is to obtain further information on the relationships within this controversial group, using behavioral data,

relative fertility determinations, and possibly other physiological techniques. It is hoped that the greatest possible number of hybrid crosses among these species may be studied, and there is need of first generation male hybrids of known parentage for this purpose. Any aviculturist who happens to possess such birds, and who is willing to lend them to the Department for this project, could assist greatly. It would be appreciated if interested persons would write Charles G. Sibley or Paul A. Johnsgard, at Cornell University, Ithaca, New York.

COOPER SOCIETY MEETINGS

SOUTHERN DIVISION

MAY.—The regular meeting of the Southern Division of the Cooper Ornithological Society was held on May 29, 1956, at the Los Angeles County Museum. The following names were proposed for membership: Allen E. Anderson, 37 Orchard Park, Dexter, N.M., by Wayne H. Bohl; Bruce K. Harris, 24810 Newhall Ave., Newhall, Calif., by Gale Monson; and Hubert Loomis Smith, 232 South Park View St., Los Angeles 57, Calif., by W. J. Sheffler.

Thomas R. Howell reported that on a field trip on May 19 many passerine birds had been observed on Coronados Island, among which were: Warbling Vireo, Hooded Oriole, and Orange-crowned, Pileolated, Townsend and Black-and-white warblers, the latter working on the face of a cave near the water's edge.

The speaker of the evening, Dr. M. Dale Arvey, of Long Beach State College, reported on "Anatomical Studies on the Bombycillidae."—DOROTHY E. GRONER, *Secretary*.

NORTHERN DIVISION

MAY.—The regular meeting of the Northern Division of the Cooper Ornithological Society was held on May 3, 1956, at the University of California, Berkeley.

Howard Cogswell reported a total of 54 Knots on April 21 in breeding plumage at Bay Farm Island. Laidlaw Williams reported that the Clark Nutcrackers were still on the Monterey Peninsula. Seven were seen at a feeding station.

Laidlaw Williams and Elmer Highley gave a report on the "Migration of Loons in Winter off the Monterey Peninsula."—LILLIAN K. HENNINGSEN, *Secretary*.

For Sale, Exchange, and Want Column—Each member of the Cooper Society is entitled to one short advertising notice in any issue of the Condor free. Notices of over 3 lines will be charged for at the rate of 25 cents per line. Send advertising copy to Jack C. von Bloeker, Jr., Los Angeles City College, 855 N. Vermont Ave., Los Angeles 29, California.

WANTED—Rifle, .22, with Routledge barrel for collecting purposes. Please give particulars as to condition and price.—JAMES T. BIALAC, 1641 W. Pierson St., Phoenix, Ariz.

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WANTED—Continuously wanted and exchanged: Embryos, young in pipped shells, or just-hatched specimens, alcohol preserved, of any identified avian species.—DAVID K. WETHERNER, *Dept. Biology, Fish University, Nashville 8, Tenn.*

FOR SALE—Many issues and complete volumes of the Western Bird-Banding Association's News from Bird-banders are available at reasonable prices. The News has completed thirty years as a quarterly publication and has an important place in ornithological literature. Write for list of issues available and prices.—EMERSON A. STONER, *President, W.B.B.A., 285 East L St., Benicia, Calif.*

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January 1, 1957

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